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SIXTH REPORT

UPON

VERMONT AGRICULTURE

BY THE

SUPERINTENDENT

OF

AGRICULTURAL AFFAIRS,

JOHN B. MEAD.

MONTPELIER, VT.:
FREEMAN STEAM PRINTING HOUSE AND BINDERY.
1880.

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1881, Oct. 11.
Gift of
Gov. Hall of Vermont.
(Gov. Pub.)

No. 15.—AN ACT ESTABLISHING A STATE SUPERINTENDENT OF AGRICULTURAL AFFAIRS.

It is hereby enacted by the General Assembly of the State of Vermont:

SEC. 1. The governor of the state is hereby authorized and directed to appoint, by and with the consent of the senate, one person who shall be state superintendent of agricultural affairs, and who shall devote his whole time to promoting the highest agricultural interests of the state, and who shall hold his office for two years or until a new appointment is made.

SEC. 2. The state superintendent of agricultural affairs shall, so far as practicable, visit each town in the state and hold public agricultural meetings therein, and procure reports thereof which reports he shall, as far as may be, cause to be published in newspapers printed in the state.

SEC. 3. The state superintendent of agricultural affairs shall receive a salary of fourteen hundred dollars per year and his official expenses, but the whole amount paid by the state under this act, including printing, shall not exceed twenty-five hundred dollars annually.

SEC. 4. All acts and parts of acts establishing a state board of agriculture, and amendments thereto, and all acts inconsistent with this act, are hereby repealed.

SEC. 5. This act to take effect from its passage.

Approved November, 26, 1878.

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REPORT

OF THE

SUPERINTENDENT.

To His Excellency, REDFIELD PROCTOR,
Governor of Vermont:

SIR:—Although not required by the law under which I have pursued my labors, nor directed by Your Excellency to make any official report of my work as superintendent of agricultural affairs, I have deemed it best both for the cause of agriculture itself, as well as that Vermont should keep in line with her sister states in this regard, so to do, and do therefore respectfully submit the following report:

The character of the work as will be exhibited in these pages will be seen not to differ materially from the work heretofore performed by the several boards of agriculture. Indeed, I could not hope to improve much upon the plan adopted by them in carrying on the work so auspiciously begun and faithfully pursued as a rule, and which had received so many commendations from the friends of the cause in other states.

It was well known by nearly all the friends of agriculture and its most zealous promoters that I was an ardent supporter of the plan first pursued by the state in its endeavors to promote the cause by a board of competent men representing, as far as practicable, the different localities in the state as well as the various departments and diversified forms of this great and growing industry. And that

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having watched, with increasing interest year by year, since the organization of the first board in 1872 and noting, as I thought, a wonderful impetus being given to the cause through the faithful and efficient labors of the men engaged in the work, it should have been no wonder that I very much doubted the expediency of such a change of policy for the future as should place the arduous task in the hands of any *one* man be he ever so able or worthy. And much more when notified that you had called *me* to the labor. I was quite ready to exclaim "Who is sufficient for these things?" The cause of this was chiefly, aside from my own keenly-felt inability, from the somewhat wide-spread feeling antagonistic to the idea that the state should do anything whatever to encourage agriculture. I had met this sentiment in my previous labors as a member of the board of agriculture, and deplored it, and was of the opinion that there was much work to be done through discussion and study and such additional means as the enlightened wisdom of an intelligent body of men might devise.

I may take occasion in another part of this report to discuss this phase of the subject, but not here and now. Suffice it to say, I was led to undertake the work, with what result let this report and my labors in nearly one hundred and fifty towns of our state be passed upon by the enlightened judgment and rare good sense of the people of Vermont. The law under which I have labored provided that I should as far as practicable visit all the towns in the state. The aim has been to approximate to this, but the season for holding meetings being confined to the fall, winter, and part of the spring months, not quite as many towns have been visited as have called for meetings, not to speak of those that have needed meetings but have not invited the superintendent. In addition to this kind of work, I have considered it in the line of my duty to respond to invitations to speak at fairs and festivals where the people were assembled, and where the subject of improved agriculture or any of its subsidiary interests was proper to be discussed.

Soon after my appointment I received a letter from President Buckham of the university of Vermont and state agricultural college to the effect that the college proposed to do some work among the

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people by way of lectures from scientific gentlemen connected with it, or under its direction, and expressing a wish that we might co-operate by way of joint labors in the holding of meetings. I consented to make the trial, and as far as I could judge it was a wise arrangement, as the people seemed much interested in the addresses of Prof. W. O. Atwater and Dr. Noah Cressy upon their special topics of Fertilization and Veterinary Science, while they are always ready to listen to the scholarly productions of Prof. G. H. Perkins. and President Buckham. The two latter gentlemen will have articles in this report. Prof. Perkins' article upon Internal Parasites, having been prepared with great care, needed to be illustrated by cuts which, at an expense of $30, I thought it wise for me to incur—that being the condition upon which I could obtain it.

The college has employed Dr. Cressy and Prof. Atwater in the giving of lectures at Burlington, and in writing articles for publication in the newspapers, the results of which are now before the people. Under its auspices, also, a system of giving prizes to young farmers in Vermont who will contend for the same in the growing of corn and potatoes, has this year been inaugurated, which insures much painstaking labor on the part of the college, and much promise of good, we believe, to that class of our people whose interest and welfare should be near the heart of every Vermonter. I trust the result of this experiment will be so satisfactory and full of promise as to be repeated upon a larger scale. It is the boys and girls of Vermont that we should interest and educate into a love of nature, her boundless stores and wonderful laws, if we would hold them to the farm and the fireside.

In addition to the co-operation received from the college, I desire to bear testimony to the general friendly assistance and courtesy tendered me upon all occasions by the officers of the state agricultural society, dairymen's association, and especially from those gentlemen who have formerly been members of some one of the boards of agriculture. They have not hesitated when opportunity presented to aid me in every possible way, realizing the many obstacles in my pathway, and evincing by their sympathy and support that the *cause* was greater than the *man* or the means used to promote

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it. I am under special obligation to many of them for their contribution of articles for this report, especially to Prof. H. M. Seely, former Sec. of the Board of Agriculture, and also to Dr. H. A. Cutting, state geologist, and Prof. Peter Collier, department chemist at Washington, for their able articles herewith presented. These gentlemen of whom I speak, with the exception of Dr. Collier, are still among us as representative men in their particular fields of observation and labor, studying and experimenting, to know more than is now known touching the possibilities of agriculture.

I found, after commencing my labors, that in order to comply with another provision of the law—viz, to so far as practicable give an account of my meetings through the papers of the state—I should need an assistant as a reporter and general aid. I was able to secure the services of Mr. O. M. Tinkham of Pomfret, a practical farmer and agricultural editor of the *Green Mountain Freeman*. As a ready reporter and easy speaker, together with his natural conservatism, he has rendered me valuable assistance.

I have also employed Mr. J. W. Sanborn, superintendent of the college farm at Hanover, N. H., at quite a number of meetings with great success, profit and acceptance to our people. Mr. Sanborn is fast gaining for himself a national reputation as an *intensely practical* man. He takes nothing for granted but always insists on the reasons and the proofs. His talks to the farmers are very acceptable, and especially because his hearers know that his deductions are formed after careful recearch and accurate experiments. He will contribute an article to this report.

I have also held several joint meetings with Mr. Conant, superintendent of education. The experiment proved a success so far as known. Mr. Conant contributes an article to this report.

With but few instances to the contrary the people have given me a cordial reception where meetings have been held. There has been evinced a feeling that the half has not yet been achieved or told touching the possibilities of agriculture in Vermont. And that in these days, when the clear and certain light of science is shed upon the mysteries and difficulties that have so hitherto hedged up our way, it behooves the man whose occupation leads him more directly into communion with nature's processes and laws, to be eager to

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know what they teach. We find this feeling to be upon the increase, and think it the legitimate fruit of the time and money spent for the cause, and would be a sufficient equivalent were no other and more substantial returns assured. We trust the subject-matter of the various papers submitted herewith will evince that the thought of our best agricultural writers and educators is to lead the farmer to a higher plane of thinking and reasoning, and that for every effect there must be a cause; that in consequence of the rapid growth of our country, its immense increase of products from the great west—with cheap freights and strong competition—together with the ravages of insects upon the crops, and those climatic changes whose laws we cannot ignore or circumvent, there are thrust upon him new questions and conditions, the considerations of which are vital to his welfare.

It has been left, comparatively, to these days for the farmer to be told that the constituent elements of his soil necessary for plant-growth are also in the rocks of our mountains. That all of the soils, in fact, except small deposits here and there, the result of aquatic vegetation and decay, have, in the wonderful processes of the ages, been ground down from the rocks. This thought makes even the stones of the quarry and the mine to possess a new interest to the farmer of to-day, and opens new fields for thought and investigation to his vision, as well as new avenues for his genius and enterprise.

I sincerely hope, in view of the great necessity that is upon us, to keep Vermont in the front rank of states, agriculturally speaking; that this increased interest so generally awakened and so heartily approved and seconded by your excellency and by the people of Vermont, will continue to grow in magnitude and rich fruit, until our barren acres shall be renovated, and the "How to do it" so well established and so easily accomplished that the large majority of our farmers will not be satisfied without making the attempt.

To this end it will, I think, be found to be wise policy for the state in some form or other to render its aid. A comparatively small outlay will bring remunerative returns. Agriculture is one of the oldest of the arts, and in some respects is still wedded, through long usage, to its rudest beginnings. It ought to-day to be ranked among the

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worthy list of sciences. That it is not, is because so little is *positively settled* that is supposed to be known. It is simply a matter of education, and it is possible the future need will be best provided for in the modification, to some extent, of the list of studies required to be taught in the common schools of the state. The adage of that old philosopher who was asked what boys and girls should be taught, replied "Those things that they will need to know about when they become men and women," is nowhere truer than when applied to those who will follow farming for a livelihood.

Let us hope that the future of our state in fostering this most noble of callings shall be equal to her reputation for intelligence and virtue; and may she not forget to encourage in every legitimate way the development of all her industrial interests, which are the true sources of wealth to the individual and weal to the republic.

For the information of such as do not know, I will add that while this report was not expected, nor provision for its publication made by the legislature of 1878, no appropriation will be asked of the present legislature, or any subsequent one with which to pay for the printing.

From the annual appropriation of eleven hundred dollars made by the act under which I have labored, for the payment of my traveling expenses and assistants, I have saved nearly enough, if not quite, to pay for the printing. If more is needed I shall incur the same.

Respectfully submitted,

JOHN B. MEAD,

Superintendent of Agricultural Affairs.

Randolph, August 15, 1880.

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THE YESTERDAY, THE TO-DAY AND THE TO-MORROW OF VERMONT AGRICULTURE.

By Prof. HENRY M. SEELY, Late Secretary of the Vermont Board of Agriculture, of Middlebury, Vt.

When I mention the topic, Vermont agriculture, I name the greatest industry of Vermont, that upon which her prosperity as a state must rest. It is a topic which should give to any speaker an inspiration, touching his heart with enthusiasm and his tongue with eloquence.

Well may the farmer of Vermont, as well as the farmer of every liberty-loving state, claim honor from his occupation. And the country honors him, for it knows that whether in peace or war, in safety or peril, he is her great support and defence. From the latest struggle for life by our own nation, backward to the earliest dawn of history the farmer has come to the rescue of his imperiled people and has earned for himself a name which has made him honorable in the annals of his countrymen.

We love to repeat the stories in which the farmer has become the hero of the age and a hero of all ages. However old these stories may be they are ever fresh and sparkling, for like the juice of the grape the flavor increases with age. Let me tell one—tell it as it has been told in some form to every generation of the past 2,000 years and more, and will be told as long as there is a generation to hear. This story is of some legislators who at a time of great national peril came to a farmer for his assistance. They were in too great straits to wait even for him to be called to his house, but went at once to the field. They found their man, this farmer, dressed for his work and following the plow. His good wife brought out to him his coat, or it may have been his dressing-gown, that he might be attired more becomingly while listening to the message which the high officials brought. They opened their case. They came as a deputation from the Roman Senate, and brought him—this plowman—a commission as dictator. They told him of his country's need. The plow was left in the furrow, for there was no time to beat its share into a sword. The danger was too great. Before daybreak he was in the forum at Rome numbering his army which

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gathered at the magic of his name. Then straight as the furrow he had made in his own field, he marched for the enemy, and faster than the strokes of his flail fell the sword upon the surrounded, surprised and soon subdued foe. That foe passed under the yoke. The Roman state was saved. The dictator's authority was resigned, and in fourteen days from leaving his farm Cincinnatus was at his plow again.

And from Cincinnatus down we might set forth a long procession of brilliant names of those who have left their farms for their country's perilous service, and made a country worth living for.

Diverse as may be our callings, and as distant as may be our homes, there is a common weal that binds us who gather here, for the same commonwealth is ours. The name *Vermont*, whenever and wherever spoken, should touch a cord making our hearts thrill in unison. May the charm which lingers with this word never be less in its power than it is to-night. I would have the patriotism of our people of Vermont be in kind and in its measure like that of the people of another storied land. There is a little spot upon the map of the eastern world which represents the most interesting of all lands, a land full of the echoes of sacred song and sacred story; a land full of the tender memories of the past, and around which clusters the prophecies and hopes of the future; a land from which its former people, persecuted and peeled, have been driven, and yet a land to which this same people, though scattered through all lands, are looking with weeping eyes and yearning hearts, and waiting for the fulness of time when they may come again to the homes of their fathers and possess this land as their own. Time and distance and circumstance, all have no power to weaken their love for this spot, and wherever they go, they go longing for the true home between the river and the sea. This patriotism of the Jew commands our respect, and making his cause our own, we will rejoice when the fulness of time shall come to see him re-planted in his loved and longed-for home.

We are here to-night not as the representatives of a dispossessed and a scattered people, but the inheritors of a land like the Holy Land, like it in size, like it in streams and mountains, and like it too, "a land flowing with milk and honey," lying between lake and river with its shaggy crest of mountains, and we call this land *Vermont*. To this land our affections should cling even with Jewish patriotism. This Vermont is ours, and this inheritance, like that of those of olden time, is a *goodly heritage*. Yet while it must always be good and goodly we have occasion to look with thoughtfulness, if not with solic-

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itude, to our future. Decade after decade, the wealth and population of our sisterhood of states is numbered up, and we wonder what shall be the position of Vermont among the states of our union in future history. Shall she maintain her relative rank, or shall she, losing her population, wealth, influence and prestige, fall back into the rear of the advancing column of states?

Look with me if you will at the source of Vermont's present prosperity, and then perhaps we may be able to discern a little more clearly what the future must bring. Does the wealth of the state consist in her commerce? No. Vermont is an inland state and Lake Champlain and its outlets offer but small opportunities for the carrying trade. Are manufactures her chief reliance? There are no beds of coal within her borders for convenient steam power, and the streams are too far away from the maritime ports to base a hope upon them as a source of general prosperity. So then, as neither the winds of heaven will waft our commerce, nor the waters of our streams furnish an industry for our whole people, we must turn to the *earth* as the source of Vermont's prosperity. Here we may rest with the assurance that we have reached the foundation of our present and future wealth. Her mines of iron, and copper and gold contribute somewhat to her income. Her quarries of slate and granite and marble add largely to her wealth. But however large may be the income from mine and quarry, not mine and quarry can determine the position of our state within the galaxy of our union. Above all commerce, all manufactures, all mining and all quarrying stands the production of the soil, what grows from the soil and what feeds upon this growth.

If Vermont then is to hold her position as in the past, and that a power for good, it will be because this position is held by her agricultural prosperity. This is the anchor which must hold her to her chosen moorings. The prosperity of the farmer is the prosperity of the state. In this light Vermont's agriculture touches most nearly each and every son of the state, whatever may be his profession or calling. He is most patriotic who contributes most to this industry of the state, and he deserves best who does most.

You then will follow me as I continue this discussion, and while I set before you the past, the present and the future of Vermont agriculture, this hope of our state.

Yesterday, the yesterday of Vermont agriculture, is gone. Its early dawn witnessed the pioneer farmer cutting his swath of timber with his ax, that his ground might be ready to yield him a crop whose harvest may be gathered by the sickles' gentler strokes. The

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freshly planted soil around the new-made home of the woodman and farmer, brought forth by handfuls. Rude were the implements, rude the agriculture, but abundant were the crops. As the years went on the woods retreated from around the houses, and broad fields appeared. The sickle cut, the barns housed, and the flail beat out the wonderful yield of wheat and other grain. Neighbor came nearer to neighbor; the school house was built, and a generation of sturdy men and women was trained in the well filled peoples' college. Strong arms toiled in the fields and busy hands made the house a factory as well as a home.

Homes of comfort took the place of the early scant tenements, as the day wore on; the rude implements gave way to those better fitted for service, and were at length stored away to appear only as reminders of the past. As the sun of yesterday's Vermont farming went down, the flail had been hung away on its nail in the corner, the sickle had been put by on the attic rafter, and the knightly men who had wielded them had been gathered in by the reaper, Death. This yesterday has passed into history, and its struggles, its self-denials and its successes are fast becoming poetic.

But alas! that with this yesterday, too, has gone the early fertility of the soil, the barns bursting with grain, and still more sadly the homes and the school houses over-flowing with children. But however tender the memories or poetic the associations of yesterday, the day is gone and we may not linger over it, but address ourselves to the to-day.

This to-day is especially characterized by the implements which come to the farmer's help. The single individual man is over-topped by mechanical aids; horse and steam power take the place of man's bodily power; arms of wood and fingers of steel are outstretched to help him. In the meadow the mower, the tedder, the horse rake, and now the hay loader and the horse fork make quick work with the hay crop; while in the grain field and at the barn the reaper and the threshing machine secure the crop and prepare it for market. As the *sickle* is the symbol of the yesterday of farming, so may the *reaper* stand as the representative of that of to-day.

Leaving these symbols and these representatives, a hasty glance at the field of Vermont agriculture as it is, will aid us in judging what it may be in the future.

To-day we have within the limits of the state near four and a half millions of acres of land, over three millions of which are improved, making in round numbers, thirty-four thousand farms of one hundred

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and thirty-four acres each, and valued at one hundred and thirty-nine millions of dollars.

But tilling the soil does not constitute wholly the industry of the farm. As in ages past, herds and flocks are a portion of a farmer's wealth and yield him a part of his income. So the land, the farming implements for working the land, and the farm stock constitute a capital of not far from one hundred and fifty millions of dollars, which, including improvements, brought, in the the year 1870, an income of thirty-four millions of dollars. Such, then, is the agricultural capital and such the annual agricultural income of Vermont. Look at it, and let us ask whether we have reached the limit of our prosperity? Let us ask ourselves whether from this moment we shall advance or recede?

Before we say that we will advance, let us look at our discouragements. We shall do wrong to underrate them.

Our acres are depleted, for the abundant crops of grain which our fathers took to market, took with them the fresh fertility of the soil. Armies of weeds are battling for a place upon our fields; hosts of insects are coming like the locusts of old to eat up every green thing. We are pressed by competitors who have a milder climate and a more easily tilled soil. Our native people are replaced by foreigners. Our rural towns are becoming depopulated. Our families are smaller. We are wasteful in our habits, and lack economy on our farms. I will not try to complete the list, but will say that in spite of all our discouragements the census of the United States shows that Vermont has, decade after decade, been advancing with steady step. It is true that some industries have declined, but the movement as a whole has been onward; and with allowance for the present depression, Vermont is in advance of any position she has hitherto attained.

Whatever Vermont may or may not have been in the past, here our good state is anchored, and with the rise or with the fall of her agricultural industry, so rises and so falls her prosperity and power. We must make the most of her rugged mountains, and use to the utmost her fertile valleys. While we are not to underestimate the difficulties in the way of progress, we also are not to be disheartened by them. Alongside these difficulties we must put the advantages we possess, and the opportunities just within our reach.

As just stated, we have in Vermont a capital of one hundred and fifty millions of dollars invested in lands, implements, and farm stock; and an income that may be fairly estimated at thirty-three millions. The larger items of income are from our meadows and pastures; and

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if the products from these can be increased, and especially largely increased, our increased income is assured.

The hay crop of Vermont is worth about ten millions of dollars, while from the pastures in the form of butter, cheese, fat cattle and wool, not far from ten million more are realized. Grain, roots, seeds, sugar, and the like come in to make up the third ten millions.

This income is realized from a depleted soil, and by a careless system of cultivation. While I speak of a *depleted* soil, I wish to distinguish it from an *exhausted* soil. We can hardly have too high an estimation of the soil of Vermont. This soil has that *staying* or *enduring* quality, which renders it next to inexhaustible; and a hundred years hence, yes, in half that time, the agriculture of the state will be in advance of an equal acreage of the best prairies of the west When those fields shall be abandoned, or only cultivated with poor remuneration, the farms of Vermont will, with proper care, be developing an increased fertility. Not in degree, it is true, but in character, the valleys of Vermont are like the valley of Egypt. This permanent fertility of our valleys is one of the most cheering features in the agriculture of our state. Wasteful farming may injure these rich fields and make them unremunerative for a time, but no manner of ill-treatment can make them permanently sterile. Left to themselves, they will ultimately recover their productiveness.

Such are Vermont's valleys. Her hill-sides, though less productive, still afford the sweetest pasturage for flocks and herds, and the sheep, the horses, and the cows of Vermont have a well-earned and valuable reputation throughout the Union.

Along our mountain flanks we have the best possible localities for the growth of the potato, and conditions not unlike those found in its Peruvian home. In the markets of the cities the potato from Vermont has taken the first place and the first price. Nor is this all; varieties originating in Vermont are displacing—largely displacing—others from cultivation not only in our own country but in the old world.

The opportunity for growing hardy and long-keeping fruits has probably never been fully realized. The islands and shores of Lake Champlain have a soil and climate adapted to the growing of fruits with the greatest success, and these localities must before long become the fruit garden of New England.

The sugar and the honey industries of Vermont to-day are in every way encouraging, and each is capable of great development. But I must not delay to give even a full outline of Vermont agriculture. This outline, if you would fill in, you can do so at leisure from the

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census of the United States, the reports of the department of agriculture, and from the statistical articles in the reports of the Vermont board of agriculture.

This glance at the to-day of agriculture is that we may predict its to-morrow. And what of to-morrow? No human eye, unless endowed with prophetic vision, can look into its events. But as one at our central government gathers from statistics, far and near, the certainties of to-day, he combines these into the probabilities and accepted predictions of to-morrow. So our knowledge of Vermont to-day will, when rightly comprehended, enable us to forecast Vermont't to-morrow. And if one now asks *What of To-morrow?* the answer comes back—As To-day, but more abundant—yes, as *double*, and, not in the far future, as *treble*. Such is the answer of those who have most carefully forecast the possibilities of Vermont's future. Their's is a dream, do you say? Yes, I will admit it. But in this sense alone; as the block of marble is a dream of the statue that shall come out from under the sculptor's chisel, as the sowing is the dream of the reaping, or as the boy is the dream of the man. The sculptor's hand may lose its cunning, hail may injure the harvest, sickness may check the developmet of a manly frame; but the possibilities of the marble, the seed, and the youth are there. So the possibilities of Vermont farming reveal themselves to those who look carefully to the promises of the future. If these possibilities are not realized and this better to-morrow not so abundant as is predicted, it will be because of a lack of skill or a lack of faithfulness on the part of the farmers.

Let me re-state my belief: and this is, that Vermont may in the remaining years of this century easily bring us *twice* the income we receive to-day; and that the one hundred and fifty millions of agricultural capital may, and ought to be so managed and increased that the next generation shall have a yeaarly income from it of a *hundred millions*. In this generation, then, the income should be *doubled* and during the next, *trebled*.

Hear me patiently, if you will, as I point out the line of improvement along which the farmers of Vermont must travel to secure the desired result. To obtain this double income, Vermont cannot perform that sleight-of-hand trick known among diplomatists as "rectifying the border," and by the operation double her acres. The Champlain and the Connecticut are pretty well defined borders east and west.

It will hardly do just yet to seize Canada on the north, and on the south Massachusetts is a little too strong for us. So we can

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hardly hope for any increase of lands along our borders. But we can do better than this, better for ourselves, than by gaining land by forays and invasions. Throughout the length and breadth of our state are acres on acres which may be won to our arable fields by peaceful weapons, the spade and the draining tile. Not then to dispossess our neighbors of their lands, but to secure returns from those already rightfully our own, bringing from idleness to usefulness thousands of acres which shall be the most productive of our state is the first step towards increasing our income.

To bring up our agricultural income to the highest point of productiveness there must be a combination of capital, science, skill, industry and economy. We must *know* or in other words have the science, and then knowing *do*. To bring in a generous enthusiasm among the farmers of Vermont, to have deeply implanted in their hearts the determination to do, to do this year better than they did last, and to purpose to do better next year than they are doing this, will aid wonderfully in increasing the income from the farm.

One may sincerely inquire whether there be this need of rousing the farmers of our state to undertake better culture, and many even assert that their own material interests will lead them to do their best, their very best, in their calling. But we shall be convinced that as a class they do need to be stimulated. If we consult the last census of the United States, or if we look at the reports of the department of agriculture we will see that they are not doing their best. While Vermont is fully abreast and even ahead of many of the states, ought we to be satisfied with the present yield of our crops? Ought we to be willing that our cornfields should continue to average us but thirty-seven bushels to the acre? And wheat seventeen and a half, and other cereals in proportion? And with grass are we doing the best we can? With this crop which we say is king—grass which is the pride and boast of our state, shall we be satisfied to continue the present product at less than a single ton to the acre? I trust not.

Looking at such returns, are we dreaming when we say that each and every one of these crops *may be* and *ought to be* doubled? We are not among those who take up the lament that the fertility of the fields of Vermont is gone beyond recovery; or sit down and wring our hands saying that the time of Vermont's prosperity is gone and gone forever.

Even with a poor soil we might hope by careful cultivation to arrive at more satisfactory results. Look at examples from abroad, at the marvels performed on the most unpromising soils. "In Holland

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vast wastes have been rescued from the ocean, sterile marshes and barren sands have been converted into productive fields, the very garden of Europe."

"The soil of Belgium was originally sand and clay alone, yet it has been enriched by composts and cultivated for years, until it has become a rich, black, loamy mould; every expedient has been resorted to, both to increase the quantity and to improve the quality of fertilizers for the soil. Yet Belgium not only sustains the densest population in Europe, or 460 to the square mile, with scarcely any imported food, but carries to each thousand inhabitants 54 horses, 236 head of cattle, 112 sheep, 120 swine and 38 goats."

It is an error to suppose that cultivation of necessity impoverishes the soil. Just the reverse ought to be the case. In England as elsewhere this has been proved true over and over again. So long ago as the time of Queen Elizabeth, just when tramping, such as probably the world had never seen before, was suppressed, and the crowds of sturdy wandering beggars were turned into useful laborers the long tilled soil showed itself capable of almost unexampled improvement. "Change in the system brought about a taste for new and better modes of agriculture. As a more careful and constant cultivation was introduced a greater number of hands were required on every farm, so idle men found the employment which the newly made laws compelled them to seek The breed of horses and cattle was improved and a far greater use made of manure and dressings. One acre under the new system produced, it was said, as much as two under the old." Thus in a few years even, the crop was doubled.

And later the waste and barren places of England, "her chalk downs have been covered with the sweetest herbage, the sandy plains of Norfolk, the fens of Lincolnshire, far inferior in natural fertility to the average New England farm, have been transformed into luxuriant fields of wheat, clover and turnips."

"About the middle of last century a lighthouse, known as Dunston Pillar, was built on Lincoln Heath in Lincolnshire, England. It was erected to guide travelers over a trackless barren waste, a very desert, almost in the heart of England; and long it served its useful purpose.

That pillar, no longer a lighthouse, now stands in the midst of a fertile farming region, where all the land is in high cultivation." Climb to the top of Dunston Pillar to-day. Look east and west and north and south. Not a single rod of barren soil appears, but on every hand green fields, abundant crops and well kept herds and

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flocks. Such has been the upspringing from this barren waste under the hand of the intelligent farmer. Here appears not simply the doubling of the crop, but the multiplication a thousand fold.

With such examples before us, is it strange that we should assert that the crop of grain in our state can be, and ought to be, speedily doubled? Faith, not in sandy heaths, but in the fertile soil of Vermont, emphasizes the fact.

Is there not a call for some missionary who shall go from town to town, from county to county, from one end of the state to the other and proclaim the doctrine of practical fertilization of our soil? We may take heart in the truth that the science of manuring is year by year more and more fully developed. May we not most truly say that better fertilization joined with better culture shall give us right speedily a land teeming with double and even many fold crops?

It is well known that one large item of income to our state is the hay crop, worth ten millions a year. Yet it is a result unworthy of the character of the farmers of Vermont, that the million of tons should be be cut from meadows averaging less than a single ton to the acre.

Lack of proper care and proper fertilization will account in part for this meagre crop. But a part is also due to the lack of adaptation of the variety of grass to the locality. Meadows high and low, moist and dry, are seeded mostly to one and the same kind of grass. There is not the slightest room for doubt that the judicious selection and mingling of seed with proper manuring of fields would raise this yield to two tons each acre, and thus by one stroke ten millions of money would be added to Vermont's yearly income.

With such possibilities so near we would hail with welcome words some apostle of grass culture who should rouse our farmers to this fact. The true story of a German farmer who became his country's benefactor is worth repeating. The story is this: This farmer had found out the value of the clover plant when it was scarcely known in Germany, and so deeply did he realize its worth to his fellow farmers, that he became literally the missionary, the apostle of clover culture. He went up and down the country proclaiming the merits of his favorite plant, and the people thought him clover mad. But he so illustrated his preaching by practice, by example and results, that he established the people in his own faith, and great was the benefit to his own land. Then came the question, what shall be done for this man, our benefactor? Royalty answered, he has ennobled his calling and he shall be welcomed into the rank with the nobles. So with the tri-parted clover leaf for his crest, he was in-

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stalled with a title which his descendants proudly bear to this day, the Knight of the Clover Field.

Room there is in our state for such a knight, and though he should remain untitled he would no less be a benefactor to Vermont.

Which of Vermont's native grasses is thus worthy of first praise and first place on her list it is yet too early to decide.

The chemist at the department of agriculture at Washington has in hand the work of deciding for us the nutritive value of these our grasses. From these or from those of some other state may come the boon to Vermont agriculture. Or it may be that the incoming benefit is to be realized from the *alfalfa* of Chili and California. While we are waiting for the knight who shall by the introduction of the right plants add ten millions to the yearly forage crop of Vermont, we may urge the farmers to use to their utmost the means now at their command, and possibly before he, the noble knight, really comes, their meadows will everywhere bear two spires of grass where but one grew before.

The subject of producing better farm stock is one that cannot be brought too prominently before our farmers. As Vermonters, we have cause for a just self-congratulation of our past and present achievements in this department of husbandry. The horses of Vermont are renowned the world over. This state is leading the world in the development of Merino sheep, which have trebled the amount of wool which their early American ancestors bore, while at the same time the fleece has gained in fineness, and the sheep in constitution. Our cows are commanding the highest price in the city markets

But in all these branches of stock-rearing there is still wide room for improvement. Pobably in no direction does this improvement point to such immediate remuneration as in that of stock for the dairy.

It would no doubt be regarded as a grievous, a high-handed act, if the general assembly of the state should establish a commission of farmers, who should be empowered to pass through the state and to call upon each farmer making butter to show a record of each cow, and then if any cow was found below a given standard in butter product, should order that animal to be fattened and sent to the butcher. We probably would not submit a moment to such a law. We would regard such an act by legislature as trampling upon our personal rights.

Nevertheless, a commission so empowered and doing its work faithfully, would add immensely to the value of the cows of Vermont.

A gentleman of New York, accepted as authority in Vermont,

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writes that in a herd of native cows only one in three, is valuable for the dairy. Intelligent dairymen in our own state say that many of the cows of a common herd are a positive damage to the farmer owning them, and that in time he would become bankrupt were it not that in the same herd there are remarkably good ones which make up the loss resulting from the keeping of the poor, and at the same time yield enough extra profit to give the dairyman a fair margin of income. If a farmer owning such a herd of dissimilar cows could be saved from himself, if by some strong hand, the worse than worthless cows could be weeded out, he would grow rich from the remainder.

The beneficent results which law may not reach by a single stroke, may, we trust, in time be accomplished by gentler means. The farmer must be induced himself to enter upon the work, having previously been convinced that he cannot afford any longer to continue his present hap-hazard method of keeping his stock.

A standard which shall be agreed upon by dairymen may be adopted; not a standard of breeding or blood, but a standard determined by actual trial of the results in butter or its equivalent, cheese. Already this good work has been begun. Some of our best dairymen have set up for themselves a standard for their own herd; and they have the nerve to send to the butcher such individuals as fall below this standard, whatever be their beauty or their blood. In a little time their herds will have a reputation throughout the land and they will reap a rich reward for the sacrifice which they now seem to be making.

Let me point out the results accruing to Vermont if such a course can be agreed upon and successfully carried out. According to the census of 1870 the state of Vermont had in round numbers one hundred and eighty thousand cows, giving an estimated butter product of over twenty-one millions of pounds, which, at nineteen cents per pound, would yield a little over four millions of dollars. And yet the average product was but a fraction over one hundred and eighteen pounds to each cow. Now there are not only single cows but whole herds within the state which yield three hundred pounds each. The average cow, then, produces a little over one hundred and eighteen pounds, the improved one, three hundred. This being so, what a vast number of cows there must be which fall below even this average, and must be worse than nothing for the purpose they are used, the production of butter! The cost of their keeping is greater than the income from their milk—the more a man has the poorer he is.

The remedy is near at hand if the farmer will apply it; and this is

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to test the butter-producing power of each member of his herd, a process not costly nor uncertain. If the cow goes below the standard of profit she is to be fattened. So the poor and unproductive cows will be weeded out, and the profits of the good ones not be lost by their keeping. Then year by year the standard may be raised perhaps five pounds each year, and the product of Vermont herds will run up to 150, 160, 170, 180, 190, 200 pounds, and so on until the mark 300 pounds will be reached. This plan is perfectly feasible. The butter product of Vermont will then be instead of four millions more than ten millions in value.

Another fact in this connection must be mentioned. As the butter increases in quantity it is found to increase equally in quality, and a half more can be realized, so that the annual butter product of the state will be raised from four to fifteen millions of dollars.

Nor is this all. During this selection and "the survival of the fittest," a race of cows will be raised up whose value will be vastly in advance of those we now have. By the slight advance of ten dollars each, nearly two millions will be added to the value of our stock.

I have dwelt upon this topic for the purpose of showing the opportunity of advance in one of the chief industries of Vermont, and at the same time showing one of the practical problems which men, solicitous in regard to the advance of our agriculture, have in hand.

The source of our future sugar supply is a topic which will soon be demanding much consideration. It is estimated by careful observers that our maple sugar crop can be doubled, while the quality can be greatly improved.

A head of white clover is but a little thing, but if one could gather up all the sweets in these pure little globes of white, a fortune could year by year be realized from them. Bee-keepers tell us that a basswood tree is more valuable for sweet than a maple. Their little partners in the work of sugar-making tap the flower, rather than the trunk, to obtain the pure nectar.

But it is of the sugar industry in another form, looming up with great importance, that I would briefly speak.

Sugar has become one of the necessities of civilized life, and is now one of the great items of expense in every household. The subject of its supply appeals to every individual.

We must be no longer dependent on foreign sources. Our own soil must give us generously this needed article. And our soil is as rich in sweet-producing properties as any the sun shines upon. Shall the beet, the amber cane, or the corn furnish our future supply? A

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few years may delay the answer, but in good time the right answer is sure to come.

But I must not continue this discussion by attempting to bring out in the short hour all the promising features of the future—the To-morrow of Vermont agriculture. The clear-eyed farmer has confidence in Vermont as a farming state. He looks forward and sees every arable acre of land by drainage and tillage made available; and every unprofitable acre remanded to its primitive office of bearing timber. He looks for better results in every respect. He anticipates the time when better pastures, better meadows, better plowed fields will yield better crops of grass, of hay, of grain, of roots, of fruit; that better stock will be better bred, and better cared for; that the butter and the cheese, the wool, and the sugar, will be more and better, and that with better methods and better markets, the best possible income shall be secured.

While we will admit that Vermont is a *good* state to emigrate from we must emphasize the fact that it is a *better* state to live in. We should look with jealous eyes upon those agencies which, under a false light, would lure from our midst the bone and sinew of our farming community.

According to the last United States census Vermont had in round numbers a population of three hundred and thirty thousand; of these only two hundred and forty-three thousand were "to the manor born"—were natives of the state. From estimates based upon this census there are two hundred thousand who, born within the state, are not now residents of it; a number equal to *four-fifths* of all the natives of the state within it.

We cannot expect that all who are born within a state should remain their life-time in it. It is desirable that there be some interchange of population. Vermont ought to send out some leaven to lighten the great western and southern lump. But the loss of two hundred thousand Vermonters from our state is too great, quite too great to be borne without damage.

Emigration societies send out their agents and gather people from central Europe, from Russia, and even from Iceland, and estimate their immigrants, man, woman and child, to be worth one thousand dollars apiece.

What a Vermonter may be worth, will depend upon the man. At a state institution at Windsor men are below par, indeed are not worth the taking. At the state institution at Montpelier —the state house—we may trust that representatives and senators are above price. Our upright governors, our eminent senators in

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congress are worth untold wealth to Vermont. The young educated, intelligent, enterprising Vermonter would be cheap at ten thousand dollars, and the average one low at five thousand dollars. And this sum, five thousand dollars, is lost to the state whenever one sets his foot across the line to return no more as a citizen. The loss by emigration has been vast, and at the estimate set Vermont has contributed to other states and territories a capital of one billion of dollars.

Those who have gone forth from among us have been mostly those in the prime of their youth. Their places could not well be filled, and their absence has told severely upon our prosperity. And they, too, have often gone to their own detriment. They have found that "far-fetched is dear-bought," and while many are doing well in their new-found homes the majority would, with the same enterprise, have been better off if they had made their native state their permanent home. The thought that Vermont was a small state, with a sterile soil, and with few opportunities for advancement, made them uneasy, and they took themselves away from the state of their birth.

This wrong thought should be corrected. The flower of our land ought to know the truth and act upon it; the truth that their native state offers a soil as permanently rich, an agriculture as thoroughly remunerative, as any of the far-away western states. For the farmer as well as for the artisan and the professional man, Vermont offers opportunities for advancement and competence scarcely exceeded by any state, and the sooner the young people of Vermont learn this the better it will be for them and for us.

This thought should be repeated and made to ring through all our valleys and echo from all our hills—*Vermont for Vermonters!* Open the eyes of our people to the advantages presented them at home and they will be no longer looking with eager gaze to the mirage that spreads over the breadth of the far away states. Let them know that, wherever they wander, the sun shines upon no place where surer competence or more solid comfort can be obtained than in Vermont. Let them know all this and the outgoing tide of emigration will be stayed, and the power of our young men will be saved for the development of the resources of our own state. And those who may go forth will look back with regret and with the yearning of the Israelite for the hills and valleys of his early home.

These two hundred thousand Vermonters, could they in part have been saved to the state, what an impulse they would have given it! Every industry would feel the touch, the thrill, of their enterprise. The soil, well-tilled, would yield double to the increased

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number within our borders. With improved agriculture would come an increase of population on our farms.

The cities are recruited from the country; and much do the cities need the infusion of virtue that comes from the country. From the farms have come and must come the men of strength, men in the halls of legislation, in the work of education, in all the professions that make for the good of man; in the pulpit, at the bar, in the sick-room, in the counting-room, at the printing-press; in all positions of honor and power.

Men, men are wanted: men from sturdy Vermont, men for Vermont. Green Mountain boys and Green Mountain girls are wanted —wanted more than all improved stock, more than Merino sheep or Jersey cows or Morgan horses. We may well take up the prophetic cry and call to Bennington and Windham, to Essex and Orleans and Franklin, "Give up O south, and keep not back O north!"

And now let me reverently say that we need more faith in the Hand that has hitherto guided our Nation as well as our Commonwealth. We need faith in the agricultural security of Vermont. This goodly heritage has the promise of seed time and harvest. Blessings are promised the faithful and obedient. "Subdue the earth," is the command. Vermont is ours to subdue. "As it was in the beginning, is now and ever shall be," such is the working of God with man. Almost creative power seems given to man. Flowers, fruits, grains, cattle, all seem plastic in his hand, and he moulds almost as he wishes. Man takes the worthless fruit-tree and after generations of pruning, crossing, and enriching, he has a fruit more melting, more delicious, than any production gathered from the fabled garden of the gods.

Faith, I say, we ought to have in Him who is "the same yesterday, to-day and forever; "faith, that obedience to the command, "Subdue the earth," will cause Vermont's agriculture to develop as the fruits from their primitive stock have done.

The Yesterday of Vermont agriculture was like the blooming of some choice tree, beautiful, but soon past. The To-day is the time of greenness and slow growth, the time of watching and pruning and thinning. The work of this To-day, well done, will bring in the To-morrow—this To-morrow, full and rich and ripe with its luscious fruit.

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IMPROVEMENT OF PASTURE LANDS IN CHAMPLAIN VALLEY.

By Hon. F. D. DOUGLAS, Whiting.

There is perhaps no agricultural subject of more vital importance to the people of Vermont than improvement of pasture lands. Our agriculture does, and must necessarily for a long time to come, partake largely of a pastoral nature. Our financial success, and through this channel our social prosperity, is mainly dependent upon our flocks and herds. These draw their sustenance during a large portion of the year from the pasture lands of the state, and their numbers, quality, and value will be determined, to a great extent, by the fertility of the lands on which they graze. While this subject thus becomes of great importance to every Vermonter, it has not yet received that attention which its importance demands.

PRESENT CONDITION.

There are many thousands of acres of pasture lands within the limits of Vermont, which once afforded the best and most abundant pasturage, which to-day scarcely pay for fencing, while deterioration everywhere is the rule with few and very limited exceptions. This depletion of natural fertility entails an aggregate annual loss to individuals, and the state, of untold thousands of dollars,—a needless waste of natural resources.

This deterioration is especially observable in the clay pastures of Champlain valley, of which I propose to speak more particularly at this time. Pastures once uniformly covered with a dense sward, made up of a great variety of the most nutritious grasses, we now find almost completely denuded of vegetation. White clover has given place to worthless "white-grass;" luxuriance, to a dwarfed and sickly herbage; large flocks and herds to small ones, or where numbers are not greatly reduced, gaunt poverty and leanness has taken the place of that symmetrical development which a vigorous growth insures.

This is especially the case in seasons of drouth like the present, and when preceded by warm open winters like the past, made up of

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a succession sudden changes in temperature, the effect is still more ruinous. The changed condition of the pastures themselves renders them much more susceptible to the evil effects of climatic influences. Restore them to their former condition and drouth, which we now so much dread, would become comparatively harmless, while their average productive capacity would be increased many fold.

FORMER REPUTATION.

Champlain valley once had the reputation of being the finest grazing region of New England, while upon these now deteriorated pasture lands much of that wheat was raised which, by its abundant yield and superior quality, gave it equal note as a wheat-growing section.

Time was when the butchers of Brighton claimed that they could distinguish between the grass-fed beef fattened in this valley, and that from other sections, by its superior quality, while the large herds both of cattle and sheep annually taken to that market furnished ample evidence of equal superiority in the amount of feed produced.

It is a humiliating fact as well as one of serious import in a financial point of view, that with past and present management our lands are justly losing their former good reputation and pecuniary value.

CAN THEY BE RESTORED?

That they can be restored is abundantly proved by the experience and example of other countries. The history which I have given is but the repetition of common agricultural history. It would seem from the observation of the past, that it is the nature of man to rob the soil when first appropriated to agricultural purposes, and to continue the operation until nature herself rebels, and refuses to yield further her stores, and he is compelled from sheer necessity to restore to her a part at least of his plunderings or starve.

It is stated by apparently good authority that more than 10,000,000 of acres in England alone have been thus overrun, and by the application of science, and the adoption, by its aid, of intelligent systems of agriculture, now rank among the most productive lands in the world. Our soil has not yet become as barren and worthless as the English heaths described by Macaulay, but with past and present management it is only a question of time when they will become so, and shall Vermont intelligence and enterprise permit a complete repetition of English experience in our own case? Shall we delay the work of restoration until compelled by utter barrenness to do so?

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SYSTEMATIC EFFORTS REQUIRED.

What we obviously need in relation to our pasture lands is the adoption of some intelligent system which, while it affords a greatly increased present profit will, at the same time, gradually increase the productive capacity of the soil, both by the accumulation of the available elements of plant growth and the improvement of its mechanical condition. This system should be, so far as possible, self-supporting, should be capable of drawing mainly from the land itself and from the atmosphere the means of restoration.

ENGLISH SYSTEMS IMPRACTICABLE.

The high price of labor with us, the comparative cheapness of our best lands and agricultural productions, together with the want of capital, will not permit of the adoption of expensive English systems. Under these changed conditions their adoption here would be ruinous. We must devise and apply for ourselves systems better adapted to our circumstances. The question for Vermont farmers to solve, each for himself, is,

WHAT SHALL THESE BE?

We can lay down no arbitrary rules which will apply with mathematical precision in all cases, but we can understand general principles and learn to apply them to our individual necessities. It is the province of reason to inquire into the causes which have led to the evils which we would remedy, to understand the conditions which develop fertility, and those which lead to opposite results, and, so far as possible, to supply the former and remove the latter. Let us in this connection inquire

WHAT ARE THE CONDITIONS OF FERTILITY?

1. The presence in the soil of all the mineral elements which enter into the composition of plants, and which have been made available by the disintegration of the original rock, or which have been deposited in an available form from other sources.

2. The presence of an abundant supply of organic matter which has accumulated from the growth and decay of vegetation and which, in clayey lands devoted to grass, should be found near the surface, providing not only a rich mellow bed for the reception of seeds and grass-roots, but serving as a mulch for their protection from the frosts of winter and the scorching heats of the summer's sun.

3. A mellow, friable mechanical condition, which will readily absorb moisture and resist evaporation; which will enable the plant

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roots to penetrate the soil in all directions, and draw food and moisture from the greatest depths below the surface.

4. In addition to these conditions, there must be found the necessary supply and variety of well-developed seeds of grass and clover from which to germinate a healthy, vigorous plant growth. We cannot reasonably depend wholly upon germination from the roots for the renewal of our swards, even with ordinary pasture grasses. These, as well as other plants, become less vigorous by age; they also degenerate under unfavorable conditions, and must from time to time be renewed from seeds of well-developed stock, if we would insure the best results.

CAUSES OF EXHAUSTION.

The first condition of fertility we have, even in these run-out pastures. The mineral elements required for the production of grass are not easily exhausted from Vermont soil. Our clay lands especially afford ample means, in this respect, for self-restoration, when the proper conditions are provided.

The second condition, viz., the presence of organic deposit, is wanting. It has gradually disappeared with the loss of original fertility. Let us investigate this matter closely and determine, if we can, the nature of the change which has come over the soil of these so called "worn-out" pastures.

FORMER CONDITION OF THE SOIL.

Once the surface was covered with a dark, rich mould, the result of the growth and decay of vegetation. Farther down, a discoloration of the soil, to a greater or less extent, indicated the presence of organic matter blended with it. This afforded not only an abundant supply of plant food, but a mellow bed favorable for the reception and germination of seeds and a rapid, vigorous plant growth. Serving as a mulch, it afforded protection to the grass roots and also to the soil itself, causing the latter to maintain that mellow, friable state which I have named as the third condition of fertility. With such conditions the soil was filled to a considerable depth with a complete network of vigorous grass-roots, giving a healthy sward, yielding an abundant supply of feed and rendering close cropping unnecessary. In wet seasons, more or less seed was matured, fell and germinated, and thus the sward was replenished with young and healthy plants.

These conditions of the soil led to their natural results, an abundant supply—even in times of drouth—of sweet, nutritious, though perhaps withered pasturage, which had accumulated during the early

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part of the season, growing long after the effects of a similar drouth would, with present conditions, have put a stop to vegetation, and being readily renewed on the first return of rainy weather.

With such conditions, the farmer could well afford to leave enough of uncropped grass upon his pastures to furnish the necessary protection from winter frosts and to replenish the supply of organic deposit, and thus perpetuate fertility. Our fathers and the present generation, as a rule, have not done this. By overfeeding and mismanagement in other particulars, a complete change has been wrought in the condition of the soil of a large portion of our pasture lands.

PRESENT CONDITION.

Now, we find little or no organic deposit on the surface, or mixed with the soil. "White-faced" clay, not even discolored by the slightest amount of vegetable mould, is found everywhere. The mellow, friable seed bed has given place to a hard and almost impenetrable state Examine those fields in early spring or after long continued rains and we find them soft and muddy; the poverty-stricken sward affording little protection to the feet from the sticky clay beneath. In midsummer's drouth, when the sun is shining scorching hot, we find gaping seams and fissures and between them a baked and brick-like surface, not affording the slightest chance for grasses of any value to grow. Barrenness must necessarily result from such a condition of the soil.

One phase of the evil is found in those pastures where the clover and other valuable grasses have disappeared and have been superseded by "white grass" (*Danthonia spicata*), an utterly worthless variety, the very presence of which indicates sterility, and because of this fact is a reproach to our agriculture.* Its native home was on our dry, thinly-wooded mountain barrens, but it now finds congenial conditions for growth on our run-out valley lands, of which it is rapidly taking possession. This pest is now found on nearly all of our grass lands from which it is not excluded by a healthy, vigorous sward, and these are the exceptions, and not the rule, in a large portion of the territory of which I speak.

Since the last winter, (that of 1879–80,) which will long be remembered as a very trying one for grass lands in this valley, preceded as it was by a very dry fall, the traveler through this section must have observed large fields almost completely denuded of all vegetation, not even "white-grass" remaining; in fact presenting, at a distance,

* See Pringle's description of this grass in the Vermont Agricultural Report for 1878, page 240.

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an appearance of having been plowed. This is another phase of the evil effects of bad management, and seems to be the climax in this direction to which we are tending.

TENDENCY OF BAD MANAGEMENT.

The present condition of our pasture lands renders it almost a matter of necessity that they should be closely grazed. Over-stocking begets the necessity for continued over-stocking. The farmer very naturally keeps all the stock he can, and is often compelled to in order to meet the demands upon him; and even though his stock seems, and really is, small, in proportion to his number of acres, he finds at the close of almost every season his pastures completely shorn of all that has grown upon them and the grass-roots left unprotected, even by a light covering of uncropped grass; thus inviting the winter frosts to complete the work of ruin which his constant over-feeding began.

The sward thus ruined, what are the chances for recuperation? No seed has matured and fallen to germinate and replace the plants destroyed, or if any, they are from a weak and stunted growth, which, if they germinate at all, will be feeble and dwarfed, thus ensuring degeneration in the sward which results from such conditions.

Such is the past history, and present state, of our pasture lands, and such the change which has come over them, and

HOW SHALL WE RESTORE THEM?

This can only be done by persistent, systematic effort, carried on, in many cases, under great disadvantages. With small, convenient fields, and an abundance of stable manure, the work of restoration is comparatively easy. But how shall it be accomplished under opposite circumstances? No complete system of farming can be devised which will apply in all its details to every case. The conditions are so varying that each must arrange the details of his work for himself; but each, to succeed, must be governed by correct general principles.

A loam or sandy pasture should receive a different treatment in many important particulars from a clay or marl one. A pasture which, owing to topographical conditions, cannot be plowed, must have a special treatment. The amount and value of fertilizers at command must be considered. The value of feed as affected by locality must be taken into the account. Farmers living near large villages

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where pasturage is very valuable, can afford to adopt a more expensive system than when differently located.

ADAPTATION OF THE SYSTEM PRESENTED.

The system which I shall present is best adapted to the arable clay lands of Champlain valley, where fields are large, stable manure scarce in proportion to the work to be accomplished, where feed is not sufficiently valuable to warrant large expenditures for patent fertilizers, where the soil is not adapted to the production of hoed crops, and where improved pasturage is the object sought. These circumstances demand a self-supporting system; one which will be a more or less paying one from the outset; one in which the means of fertilization must be developed from the soil itself in connection with annual production. I trust, however, that the princples of this system, and some of its details, will apply to every locality and to other than pasture lands.

DETAILS OF THE SYSTEM.

The first object sought should be to change the mechanical condition of the soil. The first step towards its accomplishment should be to plow in the fall, into narrow lands, so as to insure perfect drainage of surface water. The furrows should not be completely inverted, but left with their edges resting upon each other in a manner to facilitate the action of frost. In early spring I would sow to some crop having the least tendency to exhaustion. The pea crop is excellent for this purpose, though somewhat difficult to harvest. The addition of oats greatly improves it in this respect, though the latter are much more exhausting to the soil. To this crop I would apply Nova Scotia plaster at the rate of two hundred pounds per acre. This fertilizer is comparatively inexpensive, and is peculiarly adapted to peas and clover, and operates favorably in connection with clay soils. Sometime during the succeeding fall I would plow again and apply at that time, or during the winter, an amount of stable manure at least equal in value to that produced from the crop raised upon the land, and as much more as can be spared without robbing other fields.

APPLICATION OF MANURE.

Manure should never be applied after the ground is thawed in the spring. There is not only no time to spare for this, as the crop should invaraibly be sown as soon as the ground is in suitable condition, but there is also danger of packing the soil and rendering it hard and lumpy by traveling upon it. The fall is a good time to ap-

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ply manure, when it should be spread evenly upon the surface, for if left in heaps that, and the ground underneath it, will not be thawed in season for early work, and besides it cannot be so evenly distributed. But, with good farming, the available supply of manure in the fall will be small, amounting only to that which has accumulated during the summer. We cannot afford to lose the use of our manure by keeping it over for fall application, and besides there is ordinarily more or less loss in value by so doing. All things considered, the best time to apply manure to plowed clay lands is in the latter part of winter. It should then be left in heaps upon the snow, as there is thus less liability to waste; the manure so retarding the melting of the snow underneath it that it is held above the water which runs from the field during the thaws of spring, and is gradually deposited upon the surface after the surrounding snow has disappeared and when the ground is prepared to absorb the liquids washed from it by the spring rains.

OBJECT OF SECOND PLOWING.

The object of the second plowing is to secure a more thorough pulverization of the soil. After the second fall plowing, and exposure during two winters to the action of frosts, its mechanical condition will have undergone a great change. The hard, impenetrable surface will have given place to a mellow, friable condition, well adapted to the reception and germination of seeds, both of grain and grass.

On fields where a deposit of organic matter still remains a second plowing is also desirable in order to return this, and that which has accumulated from the decomposition of the turf, to its natural position near the surface. On most run-out lands, however, so little of this organic deposit remains that it need not be taken into the account in their management.

For the second crop I would use wheat, it being the best adapted of any, judging from my own experience, to insure good results in stocking; and it is withal a paying crop on our clay lands with good management, and when the best varieties are selected. When spring wheat is used it should be sown as early as the condition of the soil will permit, but never until the ground is dry and mellow, as nothing is more ruinous to clay soils than working them when in too moist a state.

I cannot recommend the use of oats in connection with grass seed. I have found, both in ordinary practice and by experiment, that we are less liable to secure good results in the outset, and also

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in the aftercrop of grass. In fields which have received the same treatment throughout and afterwards been divided, one part being sown with wheat and the other with oats, I have uniformly found the best results in connection with the wheat crop, even where the catch, at first seemed equally good with the oats. This was at first an unexpected result, and one which I can explain only on the supposition that the former is less exhausting to the soil than the latter.

STOCKING.

The selection of seeds to be used for stocking purposes I hold to be one of vital importance; one which more seriously affects the character and results of a system than almost any other consideration. The objects sought are, the most rapid improvement of the land consistent with present profit; the the greatest development of plant-food in the soil; the largest amount of stock-food from which to manufacture manure, and last, but not least, the continued improvement of the mechanical condition of the soil.

To accomplish these objects we should obviously use those seeds which will give us the rankest plant-growth, of the varieties best adapted to the wants of our stock; those which are the grossest feeders, which draw their sustenance from the greatest depths below, and in the largest proportion from the atmosphere above; those which by penetrating and most completely filling the soil with their roots will not only furnish by their decay the most and the best quality of future plant-food, but also aid most in the work of mechanical improvement.

I know of no crop so admirably adapted to the fulfillment of all the conditions named as clover, especially the largest varieties. In my own practice I use the "large northern," a variety not adapted—because of its very rank growth—to rich mellow soils, as under such conditions it lodges badly, but peculiarly fitted for the renovation of run-out clay soils, where there is little danger of an overgrowth.

While depending wholly upon the clover for the accomplishment of the objects sought, I would add a proportionately small amount of timothy, red-top and Alsike clover seed, to insure a thick sward, by occupying any vacancies left by the clover. After stocking to clover, I would use plaster again in the same proportion as before.

AMOUNT OF SEED.

Sufficient seed should be used to produce a thick, healthy sward, and no more. An over supply causes a dwarfed and feeble growth.

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The roots will penetrate less deeply into the soil, send out less fibrous offshoots, the plants will be more liable to suffer from drouth, and to be thrown out by frosts. At the first stocking, I would use the following proportions and amount of seed, viz.: Eight pounds large northern and three pounds Alsike clover seed, six quarts timothy and one-half bushel red-top seed. With a good catch of large clover, the smaller varieties will be overshadowed and crowded out, otherwise they will be needed.

The land should be mowed the first year at least after stocking, otherwise the sward, and even the land itself, is liable to be injured by the treading of stock, especially if the ground is made soft by frequent rains.

After being in clover two or three years, the field should be again plowed, and the same process repeated, always re-plowing while the land is full of clover roots, and never postponing it until the clover is entirely run out and its roots have disappeared from the soil. When the land has been once broken up and stocked to clover, the pea crop and one plowing may be omitted, as the mechanical condition of the soil will have so changed as to render a second plowing unnecessary. This rotation should be continued until the land has reached that degree of fertility, and the mechanical condition required, when it may be allowed to remain in pasture a much longer time.

When stocking for permanent pasturage, a different course with regard to seeding should be adopted. Large northern clover should give place to smaller varieties, Alsike and white predominating, while the proportion of timothy and red-top seed should be increased, and other varieties, such as orchard grass, blue grass, etc., be added. For pasturage the largest practicable variety of good grasses should be used, for by so doing we improve the quality and amount of feed and insure a denser and more permanent sward.

After receiving this treatment, the production of feed will have greatly increased, but there should not be a corresponding increase of stock. Let us bear in mind that the chief cause of loss of fertility was too close grazing, and not repeat the error. While somewhat more stock may be kept, the chief benefit derived from the change should be found in its improved thrift, and greater value of increase, in a greater capacity for the production of beef and dairy products, of mutton and wool.

PRACTICAL EFFECT OF THE SYSTEM.

This system when properly applied, will, while affording a greatly

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increased present profit, eventually restore our pastures to their former fertility. It is true that when unaided by the use of other fertilizers than plaster, the work of improvement will not be rapid, but the time consumed is of little importance where the profits are greatly increased from the outset and steadily continue to improve.

Most farmers, with an equally judicious management of other fields, can hasten the work of improvement in their pastures by the application of more or less stable manure drawn from these sources without material injury to them. Our pastures, as a rule, have long contributed to the fertility of our mowing and grain fields, and these ought in turn to aid in the work of restoration. But if the liquid, and other manures, now wasted were saved, and applied, there would be no necessity for such a draft. The system is self-sustaining, and will in time, unaided from external sources, accomplish the work.

THEORY OF THE SYSTEM.

The theory upon which the system is founded is obvious. If I pulverize the soil of a field by plowing, harrowing and the aid of the natural agency, frost, and thus fit it for the reception and germination of seeds, and sow it to some crop which draws its sustenance largely from the atmosphere, and from a considerable depth below the surface, and return the entire crop to the soil, and retain it there, I have added to the available plant food of the field, and also by the agency of the plant roots, have made the soil still more mellow. If with the stimulus which this changed condition imparts, I repeat the operation, I have made a still greater advance in this direction. Other conditions being the same, each succeeding crop will be larger than the one preceding, until the largest attainable yield will be secured. A constant accumulation of organic matter will result, the ultimate amount of increase being dependent upon the time consumed in the work. Practically there will be more or less waste, but with a mellow, friable surface, the proportion of this will be small, except on steep hill sides, or in localities liable to be washed by freshets. We gain much more than the harvested crop. To illustrate, if I sow a field to clover and harvest two tons per acre, I have left an equal amount of organic matter in the field in the form of roots and stubble. Add to this the stable manure produced from feeding the crop, and I have a large aggregate gain above all natural wastes. This gain comes from the atmosphere and from inorganic matter drawn much of it from a depth in the soil not reached by ordinary pasture grasses.

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THE SYSTEM A NATURAL ONE.

The system is an application of natural processes, aided by the plow and other artificial appliances. We have an illustration of the principle upon which it is founded, in our western prairies, in the vast accumulations of organic matter found in tropical regions, and on a still larger scale in the coal formation. Wherever there is plant growth, there is an increase of organic matter, and the degree of this increase will be determined by the rapidity and magnitude of the growth, and this in turn will be influenced by previous accumulations in the soil where the plant is grown.

If the plant growth is removed, before or after decomposition, there will of course be no accumulation of organic matter in the soil. We see a natural illustration of this upon our mountain sides, where the organic matter is washed from them by the rains and melting snows, and deposited upon the intervals below. We see a natural and artificial combination, tending to the same result, in the past management of our run-out pastures.

In these, as I have shown, vegetation has been dwarfed by too close cropping, and other causes, and the natural accumulations of plant food thus greatly diminished have been removed in the form of live stock and their products. And still more by the herding, especially on dairy farms, of stock in enclosures outside of the pastures, from which their droppings have not been returned to them. Add to this the natural effect of rains and melting snows, in washing away what organic matter may chance to have been deposited upon the hard surface, and we have a combination of agencies, the operation of which must necessarily ruin the most fertile soils and in time render them as barren as our mountain sides. To reverse such results, we must reverse the conditions which lead to them. By the adoption of the system which I have proposed, we not only do this, but we do it at a present profit. It is inexpensive and will pay irrespective of future results.

THE WHEAT CROP.

We promote also an element in our agriculture to which more attention should be paid in Vermont, viz., the production of wheat. I believe that in connection with this work of renovation enough wheat might profitably be raised in Champlain valley to make up for the deficiency in our home supply, and thus save the untold thousands now sent out of the state for a product naturally adapted to our climate and soil.

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I ask your earnest consideration of this subject, believing it to be one of vital importance. I do not claim perfection for the system which I have presented, but it is the best which under existing circumstances I have to offer; one which I have thoroughly tested, and which has given complete satisfaction in my own practice.

I hope the subject will be agitated, until the best possible system shall be devised and be adopted into general practice, and thus the prosperity, both of individuals and the state, be promoted.

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LIQUID MANURE.

By Z. E. JAMESON, Irasburgh.

In the oldest states the necessity of manure as an aid to successful farming is generally admitted. The farmers are very few who will sell manure from about their stables and cattle yards. The majority seem satisfied if they apply the excrements of animals and the partially rotted straw and hay mixed therewith that is made up of the bedding and waste of winter feeding, after the rains have in a degree removed much of the soluble matter. Some in barn cellars keep the manure from the weather and the liquids and solids fall together from the stable above, and the land responds surprisingly to the application of such manure. If swine are kept upon it and absorbents are used its quantity and quality is considerably improved. Yet with this last excellent practice the manurial resources of the farm are not exhausted and the manner of saving liquid manure is not convenient for all farmers. The subject of liquid manuring is not well understood or its importance appreciated. In July, 1880, the agricultural editor of the *New York Times* answers a correspondent as follows:

Liquid Manuring.—*C. E. O., Hannibal, Mo.*: The best method of applying liquid manure is to spread it from a large cask or tank mounted upon wheels. It can only be conveniently spread upon grass or young crops, and it is hardly probable that it can be done economically. The better way would be to absorb the liquids of the manure by the addition of litter of some porous kind, and if nothing better can be procured, earth or sand may be used. This can be spread with less trouble than liquid manure, and unless it is required for garden or market crops, young corn or grass, or similar purposes, the dry manure will be most convenient. At present it will not pay to use such laborious methods with common farm crops, because the ordinary methods can be applied as effectively and more cheaply.

The errors shown here are, it can be done economically; to use absorbents is not the better way, and it will pay to apply liquids, but this shows about the popular opinion. In consulting about thirty volumes of reports of the department of agriculture and the agriculture of Maine, New Hampshire, Massachusetts, Connecticut, Vermont and Indiana, very little will be found upon this subject. One

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man advocates hoppers, such as the farmers use to leach ashes, filled with vegetables, animal and mineral manures and saturated with soap-suds. The drainage is used. Several treat upon the sewerage of cities, the human urine and the general wastes of the household.

In this paper we shall try to bring to the common farmer that available light that is now needed upon, 1st, the quantity of liquid manure that may be easily saved; 2d, the manner of saving it; 3d, the method of applying it; 4th, its value as a fertilizer to crops; 5th, and the value of the earth that may be dug from under stables in preparing to save the urine.

As example or practice is more potent than theory, a description of what actually exists will give light upon all these points and encourage every man who feels that his success depends upon manure. I have just visited the farm of L. Smead of South Albany, Vt., where for about twenty-five years the liquid manure has been saved and applied. Mr. Emory Mason dug the pit under the floor of a basement stable and cemented it. It also receives the urine from an upper stable that ties up seventeen cows, the manure of which drops through the floor and the urine falls upon it and then drains into the pit, so that this manure is as rich as manure can be in the ordinary barn cellar, yet this pit, which holds sixty hogsheads, is filled from August to December, then emptied, and is filled again from December to June and is emptied again, making one hundred and twenty hogsheads of clear urine in a portion of the year, and nearly all from seventeen cows, as the basement stable referred to is used in winter for calves, sheep or young cattle, which would not add greatly to the amount of liquid. I found also that muck was used somewhat as an absorbent at this time, August 26th, and the solid manure saved with this muck is used late in the fall upon the ground plowed for wheat, so it will be all ready to sow early in the spring. His very good crops show this management judicious. Mr. Smead bought the farm thirteen years ago, and was told that the liquid manure was fully equal to the solid, but he was busy with his new farm and did not get it out for two years. After the spring's work was done the third year, he thought he would get it out and apply it to a field of grass that would yield about half a ton per acre, and which needed plowing, manuring and re-seeding. He left a space between the strips manured so as to test its value; the result surprised him and aroused the curiosity of his neighbors, for the watered strips gave a product of two tons per acre, and were rank and green with herdsgrass and clover, while the intervening spaces were very poor. This result can often be seen in the farmer's

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field where a round knoll of rank grass grows where urine has flowed. Since that experience Mr. Smead has highly valued the urine. His method of getting it out was to take up some of the stable floor over it and dip it up with pails and carry it a few steps and empty it into a hogshead that set in a wagon; when full he drove to the field and with a hammer drove in a plug or bung, and the liquid was discharged into a T shaped horizontal wooden spout with half inch holes in it. He drives the team along the field until the cask is emptied and then returns for another load. Nearly all is put upon grass, as it seems too strong for young grain, causing it to turn red, or rusty, as though salt had been sown upon it to excess. The fields of Mr. S. now have an excellent, thick-set turf and usually yield two crops of hay in a year. None of the neighbors have imitated the example, and doubtless as much liquid is wasted in many barn cellars in proportion to the stock.

In 1879 Horace Story of Irasburgh determined to make a pit under his stable where fourteen cows were kept. This stable was upon the ground floor and had been used twenty-five years or more. He took up the floor and dug the pit five feet deep and about ten feet wide on top and four feet wide on the bottom, and about thirty feet long. He cemented upon the earth with one coat of cement. It was done the first of December; in the spring it was two and a half feet deep with clear urine and gave 40 or 41 loads of 26 pails each. The tub used had formerly been used in the sugar place to hold sap, and had often been measured with sixteen quart or half bushel pails. He calls it one thousand pails full. This was applied to grass and oats. The oats were as good as where a liberal dressing of stable manure was applied. In harvesting the oats it was noticed that where the liquid was running slowly, when the tub was nearly emptied, that the crop decreased as the dressing decreased.

The earth that was dug out from under the stable was applied to barley and grass and gave good results. Mr. Story says: "My pit cost me nothing, and less than nothing, as the earth I dug out was worth more than the cost of the pit."

Mr. Story uses a common wooden pump and conductor, and can fill his tub in a very few minutes, and when the team arrives on the field the stopper is pulled out of the hole at the bottom without stopping the team, as the stopper comes up through the liquid. The load is spread as wide as the wagon and in length according to the speed of the team, from ten to twenty rods. His apparatus is more convenient than that of Mr. Smead, as the liquid runs from the bottom of the tub instead of the side near the bottom, and the stopper

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is long enough to come up through the liquid above the top of the tub, and can therefore be pulled out without any danger of the liquid getting upon the hands or clothing. The distributor is just forward of the hind wheels of the wagon, and is made of common rough boards, as tightness is not desirable; half inch holes and the cracks all help the delivery. His boys had much rather draw out the liquid manure than to draw the solid, and 30 or 40 loads are put out in less than a day.

This summer Mr. Story has put in a pit under another stable about the same size as the other. It took only one barrel of cement to cement it; it is in very compact earth. There were probably five or six cords of earth thrown out and applied to grass land. I saw it August 16th, when it had been applied three weeks, and the grass was very much increased. The weather had been mostly dry since its application, but a rain had fallen the morning of my visit and the air was laden with the odor of ammonia. I apprehend very marked results will be seen in the next year's hay crop. This cistern cost nothing, as the earth was of more value than the labor and cement, which was less than $10.

He has dug a third cistern to receive the sink and privy drainage; it is seven feet deep and ten feet across the top; one barrel of cement plastered its sides. This cistern is covered over with plank and earth. Near the lower corner of the barnyard a pit is dug, but not cemented; it is to receive the wash of the yard. This is of quite a dark color, but of much less value than the urine. The stock come into this yard all winter for drink, and in summer it is the milking yard. In drawing this wash out upon the fields it took only seven minutes to dip up a load with pails and distribute it upon a field near by. But he has another invention to draw out this water, which is to have a tight box made to set on such plank as is used for a stone boat or drag. There is a trap door or valve in the bottom of the box and as the horse is driven through the pool the water rushes up into the box, and as the box is drawn out the valve closes and remains so until it is opened upon the field.

This management of liquid manure greatly increases the farmer's stock of fertilizers and is better than to use absorbents of any kind. All the labor of getting, using and applying the absorbent is saved and the liquid saved in a much greater quantity. S. W. Johnston, M. A., says in "How Crops Feed," page 296, "Dr. Cameron justly concludes that urea enters plants unchanged, is assimilated by them and equals ammonia salts as a means of supplying nitrogen to vegetation." On page 300 he says: "These facts show that it is not

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necessary that urine should be fermented before using it as a fertilizer." Urea constitutes 3 per cent of human urine, 4 per cent of the urine of the cow, and nearly 6 per cent of the urine of the pig. Prof. Johnston estimates the value of the urine of one cow at four pounds sterling, or about $20 when compared with the price of guano. The quantity 13,000 lbs. having 900 lbs. solid matter yielding 226 lbs. of ammonia. The urine of the horse and man is estimated nearly equal, at 1000 lbs. annually, the solid matter about 60 lbs., urea 30 lbs. Boussingault found by his experiments that a cow yielded of urine 6570 lbs. in a year, containing solid matter 773 lbs, nitrogen 35 lbs. This cow was giving 19 lbs. of milk daily and 18 of urine. The horse yielded in a year 1100 lbs. urine, in which was nitrogen 30 lbs.

In regard to the changes which take place in urine, Prof. Johnston teaches that it soon begins to ferment and the urea changes to carbonate of ammonia and begins to escape into the air, thus reducing the value of the liquid—although a certain ripeness improves it for plant-food. If the urine used in the experiments of the chemist was exposed to the air at ordinary temperatures we may suppose the fermentation was more active than it would be in a pit covered over and at a low temperature.

It is not our purpose to treat this subject from a chemist's standpoint, but rather as it appears in the farmer's practice. Allusion has been made to the value of the earth excavated from the pit under the stable and its fertilizing effect upon crops. It is reasonable to suppose that if a stable has been occupied twenty or thirty years and a thousand pailsful of urine have drained through the floor annually, that the earth is fully saturated many feet in depth. The amount of urine might be estimated as occupying a space six feet wide and fifty feet deep, if it went straight downward. As illustrations of its richness the farm of Gen. W. W. Grout, in Kirby, is applicable.

In arranging his barns with a view to future farm improvements he moved two that were 36 x 50 feet each, tore down another and built a new barn 50 x 120 feet. From where the old stables were he drew earth away six feet in depth which, by its odor, appearance and effect on grass, was as strong as it could be. Hundreds of loads of the earth from where the barns stood was applied to grass with wonderful results. Those who said the barns could never be filled found that in three years the space was crowded with crops.

Gen. Grout cemented the floor of his barn cellar and a surplus of moisture is usually seen around the manure pile. He has a pit under one stable but uses absorbents in it to handle the liquid.

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E. A. Leach of Irasburgh once bought a run-down farm and had no manure to start his crops. He tore down an old hog-house and drew earth from where it stood and where it drained close by, to manure an acre and a half of corn. The neighbors said he would get no corn with that dirt, but he had the largest growth and the best piece in the neighborhood.

Many men who buy farms and have no manure, and men who take farms that are in poor condition, and there are many such in New England, such men will find a mine of fertility beneath the stables, and with this rich earth can make a good start. Then if they will only cement the pit there will be annually such an amount of liquid manure as will greatly aid them in getting paying crops.

At this time the preservation of food for cattle in silos is advocated as the means by which farms may be improved, as much more stock can be kept. But the saving of liquid manure and its judicious application must not be forgotten. Do not trust to absorbents or to barn cellars with uncemented bottoms, or to mixing manures or composting; but make a pit that will receive and retain the liquid, especially from the cow stable, and be surprised at the amount you save and the crops you produce. Mr. Story's stable floor affords no better drainage now than it has twenty years past, yet in six months he saves 4000 gallons of urine from 14 cows. Mr. Smead's barn cellar appears to me to be as well constructed as the average, and he has muck to throw upon the manure, yet he saves 120 hogsheads, probably 7200 gallons, annually.

In the Vermont Report of Agriculture, 1872, p. 419, Prof. S. W. Johnston says: "As to the relative value of the solid and liquid portions of the manure no definite answer can be given. If animals are kept on low rations the liquids are best; if rich food, grain, meal or oil cake is given the solids are best. Sometimes the nitrogen of the dung exceeds that of the urine, but while the nitrogen of the urine is adapted to immediate use as plant-food much of that in the dung is comparatively inert. The urine also contains more alkalies than the dung, and the dung contains all the phosphoric acid and most of the lime. Measured by assimilable nitrogen and alkalies the liquids are much the best; measured by phosphates the dung is the most valuable."

In the Iowa Report, 1872, page 303, A. E. Foote, in a prize essay, says: "It has been well proven by experience and chemical analysis that a pound of urine has two or three times the value of a pound of dung." This writer suggests no method of saving and applying it. The methods described in this paper are so economical, and may be

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so varied, that every farmer will be able to apply them so to be greatly benefited.

"Harris on the Pig," page 144, says: "The liquid from well fed pigs is the most valuable portion of the manure."

Many farmers have a low estimate of the absorptive and retentive power of soil because that in old barnyards the earth is not always wonderfully fertile. This can be accounted for by the rains that fall upon the yard and cause the soluble elements to sink away. Thus wells are contaminated, and subterranean streams of water bear evidence of the loss of manure. But covered earth is in a very different condition, and is more like the earth in rainless regions—as in the southern part of Peru, where there is a plain that has an incrustation of nitrate of soda several feet thick, and 40,000 tons were shipped from one port in 1854. ("How Crops Feed," page 253.)

The nitrate of potash accumulates in the earth of caves, and is leached out to use in the manufacture of gunpowder. The alkali plains towards Utah are examples of nitrates coming to the surfaces in rainless districts.

In the fertile plains of Illinois there is visible nitrification apparent after protracted drouth. Prof. Johnston says: "The nitrates are not usually fixed on the soil but remain freely soluble in water," and quotes the analysis of garden earth that after a very heavy rain contained "only 38 pounds of nitrates per acre at the depth of one foot, but after a fortnight of dry, hot, windy weather the soil was found to contain 1290 pounds of nitrate of potash per acre one foot in depth."

If the urine of one cow in one year contains 30 pounds of nitrogen twenty cows would void 600 pounds. If this drained through a stable floor 20 years, 12,000 pounds of nitrogen would be deposited. It will be reasonable to deduct one half as the quantity voided in pasture or field with decided benefit to the soil; there remains 6000 pounds wasted. As you look upon the hungry fields and listen to the entreaties of agents who wish to sell you ammoniated superphosphates, will it not suggest itself to you that under your stable are tons of manure ready for drawing? It must be used with discretion, as some of it may be too strong, if applied to the hill, for corn, but time will remedy this defect, and diffuse its strength to adjoining soil. A gentleman moved a barn and drew away a large quantity of the surface soil, then plowed the spot and sowed oats; where the stable drained a strip remained bare, nothing would grow. Around this spot the oats grew rank and green, but fell down without maturing.

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This strength shows that it might be used as concentrated manures are used, a limited quantity per acre. The urine saved in a pit and applied clear does not injure grass. Probably for corn, oats or wheat it had best be applied before the harrowing is finished, so as to be mingled with a greater quantity of surface soil than it would be if applied after the grain was sowed. It will be always and everywhere an excellent fertilizer.

ARSORBENTS.

Absorbents are generally recommemded as the best way of saving liquid manure. In applying the manure to the soil the particles of absorbents must either yield up their manurial elements to adjoining particles of soil, where the feeding roots of the plant can take them up, or else the roots must embrace or penetrate the particles of absorbents; in either case the presence of sufficient water is necessary to transport the fluid through the organism of the plant. This method has served an excellent purpose, but is indirect, like compelling the whisky drinker to carry his stimulant in a sponge instead of in a bottle.

If absorbents are used, how much is necessary to take up the urine of one cow? The average amount annually voided being estimated at 10,000 lbs., as Sprengel finds it, 13,000; and Boussingault finds it 6570, and the cow he tested drank 132 lbs. of water in a day and gave 18 lbs. of urine and 19 lbs. of milk.—("Johnston's Ag. Chem." page 461.)

A bushel of sawdust that had lain in an ice house through the summer and was nearly dry, weighed 18 lbs., and after pouring water upon it until it was saturated, it had absorbed 20 lbs. of water. Usually a pound of sawdust in the condition that it is generally used, will not hold over a pound of urine, making it necessary to use 10,000 lbs. of sawdust for one cow, and for twenty cows 200,000 lbs., and to absorb what Mr. Story actually saved from fourteen cows, (4000 gallons,) 32,000 pounds. Sand is preferred by some farmers, as its mechanical effect upon the soil is considered better than that of sawdust. One peck of fine dry sand, so dry that a moderate breeze would blow a handful away if dropped slowly two feet, weighed 26 lbs.; when 9 lbs. of water had been poured upon it it was completely saturated. It appears that the farmer must cart three pounds of sand to his barn in order to save one pound of urine so it can be transported to his field, requiring for the urine of one cow 30,000, lbs., for twenty cows, 600,000 lbs. for the whole year.

The careful farmer that uses absorbents saves some of the liquid

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manure, but the thirsty, porous earth is constantly absorbing the liquids, and like the cuttle fish nothing is released from its suction. In the barn cellars that are cemented on the bottom the liquids are trickling over the cemented edge here and there and sinking into the earth. The best way and the only way to save all the liquid manures that are voided while cattle are in the stables, is to have a cemented pit to receive it.

I find in the experience of J. K. Tobey of Calais an incident of some value. In a basement he had two pigs that were upon the earth floor, except six inches or so of muck; this had become so wet that more bedding was necessary, so more muck was dumped from the floor above, and this process was repeated through the season, until the mass of muck was eighteen inches deep, and was very wet on top. In getting it out it was found that four or five inches of the bottom was quite dry, as dry as the earth below. This would seem to show that the liquid manure had been all saved, all absorbed by the muck and it had not passed through; but Mr. Tobey came to a different conclusion, because he knew that the same portion that was now dry had been perfect mud, and the earth had absorbed the moisture from the lower strata of muck faster than it had settled down from above, and actually there had been quite a drainage to the earth below. Another idea is in regard to the pressure of the mass, if sand, muck or sawdust is used as an absorbent and is fully saturated and thrown into a heap. It is evident that an absorbent cannot retain, under pressure, what it will at first hold in suspension, as it were. As the press drives moisture from a cheese, so the additional mass added to the manure pile presses out much that has been absorbed. With this view of the case we must urge that liquid manure cannot be saved by absorbents as it can be by a water tight pit.

I recently called at a place where a nice new barn had been built and old ones removed. It was found this season that where the stable was nothing grew, while all around a bulky crop of oats were produced. The farmer said "that there was so much nitre in the soil that nothing grew, and he was going to draw some poor dirt and cover it up." Let us be thankful that all farmers in Vermont have poor dirt enough to cover such mines of fertility out of sight.

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BUILDING STONES.

WEIGHT, SPECIFIC GRAVITY, RATIO OF ABSORPTION, AND CAPABILITIES OF STANDING HEAT OF VARIOUS BUILDING STONES.

By HIRAM A. CUTTING, Ph. D., State Geologist, Vermont.

Having during the past pear instituted and carried out a series of experiments to ascertain as near as possible the capabilities of the various materials used in the construction of so-called fire-proof buildings to stand heat, I submit in tabulated form the result of such experiments, hoping they may be of use to the architects, quarrymen and insurance companies of our country, and also of some interest to others.

In connection with the capabilities of the various building stones to stand fire and water, I have taken their specific gravity and weight per cubic foot, so that the identity of the various stones could at any time be compared, and if in the working of a quarry there was a change in gravity, or weight, that it could be easily detected, and thus all who choose could know whether the tests given would apply or not.

I have procured sample specimens of the most important building stones in the United States and Canada, and after dressing them into as regular form as possible, three by four inches, and two inches in thickness, I have taken their ratio of absorption, which ratio I have expressed in units of weight, according to the amount of water taken up. If 450 units of stone absorbed one unit of water, I have expressed it thus: 1+450, meaning that the stone weighed 450 units when immersed, and 451 when taken from the water.

To accelerate the process of absorption, I have placed the specimens in water under the exhausted receiver of an air pump. I find that in this way as much water is absorbed in a few minutes as in

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days of soaking. When specimens were removed from the water, I have before weighing, dried their outside with blotting paper.

In relation to the specific gravity, I have not followed Gilmore's rule in full. He weighed the specimens in air, immersed them in water, and allowed them to remain until bubbling had ceased and then weighed them in water, after which he took them from the water, dried them outside with bibulous paper, and weighed them again in air. From this last weight he subtracted the weight in water, dividing the dry weight by the difference.

This gave a specific gravity subject to two sources of error. I have followed the more frequent custom of weighing the dry stone, using pieces of two or three pounds in weight, and then immersing them in water. After the usual saturation I have taken their weight in water, subtracting it from the dry weight in air, and then dividing the dry weight by the difference. This gives the specific gravity of the rock itself, as usually found, which is what we desire, and I believe as it would usually be in buildings constructed of the given material. The specimens were previously dried by long exposure to a temperature not exceeding 200 degrees Fah. To verify this I have taken specimens from the quarries direct, and after weighing, have brushed them over with paraffine dissolved in naphtha, weighing them again so as to ascertain the exact amount of paraffine, which made no visible change in the stone, other than to keep out water. I have then weighed in the usual way, and thus obtained the exact specific gravity of the stone as in the quarry, and I find my method, used as stated, to give the best results, and so have adopted it.

After this I have placed them in a charcoal furnace, the heat of which was shown by a standard pyrometer. In many instances I have placed them side by side with dry specimens, but have been unable to note any marked difference in the action of heat, beyond this, that the dry specimens became sooner heated. I have, however, no doubt that the capacity of a stone to absorb water is against its durability, even in warm climates, and vastly more so in the changeable and wintry climate of New England. It is here often frozen before any considerable part of the moisture from autumn rains can be evaporated.

When the specimens were heated to 600 degrees Fah., I have immersed them in water, also immersing others, or the same, if uninjured, at varying temperatures up to 800 and 900 degrees, that is, if they are not spoiled at less temperatures. I find that all these samples of building stones have stood heat without damage up to

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500 degrees. At 600 degrees, a few are injured; but the injury in many cases commences at or near that point. When cooled without immersion, they appear to the eye to be injured less, but are ready to crumble, and I think they are many times nearly as much impaired, and always somewhat injured, where water produces any injury.

I give you results in tabulated form:

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GRANITES.

NO	KIND.	LOCALITY.	Specific Gravity	Weight per cubic ft. in lbs.	Ratio of Absorption.	Degree of heat causing first appearance of injury.	Degree of heat causing first appearance or cracking or crumbling.	Degree of heat which causes general cracking and friability.	Degree of heat necessary to render it worthless.	Degree of heat necessary to melt or destroy.
1	Light Colored.....	Hallowell, Maine.....	2,638	164.8	1+790	800 Fah.	900 Fah.	950 Fah.	1,000 Fah.	1,100 Fah.
2	" "	Fox Island, Maine.....	2,642	165.1	1+680	700 "	800 "	850 "	900 "	1,000 "
3	Denning's Quarry.....	Mount Desert, Maine....	2,631	164.1	1+716	800 "	850 "	950 "	1,000 "	1,100 "
4	Light Colored.....	Rockford, Maine.....	2,600	162.5	1+482	600 "	800 "	850 "	900 "	950 "
5	Red	Red Beach, Calais, Maine	2,636	164.7	1+560	800 "	850 "	900 "	950 "	1,000 "
6	Light Colored.....	Oak Hill, Maine.... ...	2,526	157.8	1+310	800 "	850 "	900 "	950 "	1,000 "
7	Red	Stark, New Hampshire..	2,631	164.1	1+534	600 "	700 "	800 "	850 "	950 "
8	Color Medium.	Concord, New Hampshire	2,636	164.7	1+778	800 "	900 "	950 "	1,000 "	1,200 "
9	Sanborn's Quarry.....	Plymouth, New Hampshire	2,649	165.5	1+685	800 "	900 "	950 "	1,000 "	1,200 "
10	Carter's Quarry.....	Ryegate, Vermont.....	2,647	165.4	1+790	800 "	900 "	950 "	1,000 "	1,200 "
11	" "	Woodbury, Vermont....	2,654	165.8	1+784	800 "	900 "	950 "	1,000 "	1,200 "
12	Wetmore & Morse's Quarry.	Barre, Vermont.....	2,651	165.6	1+720	800 "	900 "	950 "	1,000 "	1,200 "
13	Syenite	Quincy, Massachusetts...	2,660	166.2	1+650	750 "	800 "	850 "	900 "	1,000 "
14	Gray	Groton, Connecticut.....	2,800	175.	1+818	700 "	750 "	800 "	900 "	900 "
15	Common.	Woodstock, Maryland...	2,648	165.5	1+394	700 "	750 "	800 "	900 "	900 "
16	"	Port Deposit, Maryland..	2,700	168.7	1+816	800 "	900 "	950 "	1,000 "	1,100 "
17	Scranton County Quarry..	Richmond, Virginia.....	2,727	170.5	1+398	750 "	800 "	850 "	900 "	1,000 "
18	Old Dominion Quarry.....	Richmond, Virginia.....	2,674	167.7	1+402	750 "	800 "	850 "	900 "	1,000 "
19	Light Color.....	St. Cloud, Minnesota....	2,690	168.2	1+280	700 "	700 "	800 "	850 "	900 "
20	" "	Stanstead, P. Q.....	2,833	177.	1+420	800 "	900 "	1,000 "	1,000 "	1,200 "
21	Coarse.....	North Halifax, N. S.....	2,698	168.6	1+584	700 "	800 "	800 "	900 "	900 "
22	"	Gananogue, P. O., Canada	2,687	167.9	1+736	800 "	850 "	900 "	950 "	1,000 "

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SANDSTONES.

23	Freestone	Portland, Conn	2,380	148.7	1+27	850 Fah.	900 Fah.	950 Fah.	1,000 Fah.	1,100 Fah.
24	"	North of England	2,168	135.5	1+27	850 "	900 "	950 "	950 "	1,000 "
25	Seneca Stone	Montgomery County, Md.	2,500	156.2	1+26	850 "	900 "	900 "	950 "	950 "
26	Sandstone	Salem, Md	2,452	153.2	1+24	850 "	900 "	950 "	1,000 "	1,100 "
27	"	Seneca, Md	2,410	150.6	1+40	900 "	1,000 "	1,100 "	1,200 "	1,200* "
28	Montrose Stone	Ulster County, N. Y	2,661	166.3	1+314	900 "	1,000 "	1,100 "	1,200 "	1,200 "
29	Freestone	Bellville, N. J	2,350	146.8	1+27	900 "	950 "	1,000 "	1,000 "	1,100 "
30	"	Nova Scotia	2,424	151.5	1+240	900 "	950 "	1,000 "	1,000 "	1,100 "
31	S. Carboniferous	Br. Phillips, N. S	2,353	147.0	1+19	900 "	950 "	950 "	1,000 "	1,000 "
32	Freestone	Dorchester, N. B	2,363	147.7	1+26	800 "	850 "	900 "	1,000 "	1,000 "
33	Cincinnati Stone	Cincinnati, Ohio	2,188	136.1	1+23	900 "	950 "	1,000 "	1,100 "	1,100 "
34	Potsdam Sandstone,	McBride's Corners, Ohio.	2,333	145.8	1+28	800 "	850 "	900 "	1,000 "	1,100 "
35	Berlin Stone	Cleveland, Ohio	2,210	138.1	1+22	850 "	900 "	1,000 "	1,100 "	1,100 "
36	Potsdam	McBride's Corners, Ohio.	2,500	156.2	1+22	850 "	900 "	950 "	1,000 "	1,000 "
37	Euclid Stone	Near Cleveland, Ohio	2,290	143.1	1+35	850 "	900 "	950 "	1,000 "	1,000 "
38	Berea Stone	Berea, Ohio	2,254	140.8	1+20	850 "	900 "	950 "	1,000 "	1,000 "
39	Amherst Stone	Amherst, Ohio	2,200	137.5	1+18	850 "	900 "	†	†	1,000 "
40	Brown Stone	Humbletown, Penn	2,346	146.6	1+28	850 "	900 "	950 Fah.	1,000 Fah.	1,000 "
41	Potsdam Sandstone	Beauharnois, P. Q	2,512	157.0	1+38	850 "	900 "	950 "	1,000 "	1,000 "
42	Sandstone	Murray Boy, P. Q	2,577	161.0	1+36	900 "	950 "	1,000 "	1,100 "	1,100 "
43	"	Cheat River, W. Va	2,632	164.5	1+80	800 "	850 "	900 "	1,000 "	1,100 "
44	Freestone	Acquia Creek. Va	2,183	136.4	1+16	900 "	950 "	1,000 "	1,100 "	1,200 "
45	Brown Stone	Manasses, Va	2,348	146.7	1+17	850 "	900 "	1,000 "	1,100 "	1,200 "

*Will stand greater heat.
†Changes color.

LIMESTONES.

46	Limestone	Baltimore, Md	2,917	181.8	1+340	900 Fah.	1,000 Fah.	1,100 Fah.	1,200 Fah.	1,200 Fah.
47	"	Bedford, Ind	2,478	154.8	1+280	850 "	900 "	1,000 "	1,200 "	1,200 "
48	Cincinnati Limestone	Hamilton County, Ohio	2,204	137.7	1+28	850 "	900 "	950 "	1,200 "	1,200 "

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LIMESTONES.—*Continued.*

NO	KIND.	LOCALITY.	Specific Gravity	Weight per cubic ft. in lbs.	Ratio of Absorption.	Degree of heat causing first appearance of injury.	Degree of heat causing first appearance of cracking or crumbling	Degree of heat which causes general cracking and friability.	Degree of heat necessary to render it worthless.	Degree of heat necessary to melt or destroy.
49	Potts Blue	Springfield, Penn	2,666	166.6	1+280	850 "	850 "	900 "	1,000 "	1,200 "
50	Dolimite Limestone	Owen Sound, P. O	2,571	160.6	1+480	850 "	900 "	1,100 "	1,200 "	1,200 "
51	Trenton Limestone	Montreal, P. Q	2,706	169.1	1+316	900 "	950 "	1,000 "	1,200 "	1,200 "
52	Limestone	Isle La Motte, Vt	2,696	168.5	1+320	950 "	1,000 "	1,100 "	1,200 "	1,200 "

MARBLES.

53	Tuckahoe	Westchester County, N.Y.	2,794	174.6	1+298	900 Fah.	1,000 Fah.	1,200 Fah.	1,200 Fah.	1,200 Fah.
54	Ashley Falls	Ashley Falls, N. Y	2,742	171.3	1+280	900 "	1,000 "	1,100 "	1,200 "	1,200 "
55	Snow Flake	Westchester County, N.Y.	2,848	178.0	1+380	950 "	950 "	1,000 "	1,200 "	1,200 "
56	Tennessee	Do'gherty's Qu'ry, E. Tenn	2,711	169.4	1+320	950 "	950 "	1,000 "	1,200 "	1,200 "
57	Duke Marble	Near Harper's Ferry, Va.	2,812	175.7	1+340	1,000 "	1,000 "	1,100 "	1,200 "	1,200 "
58	Black Marble	Isle La Motte, Vt	2,682	176.6	1+320	1,000 "	1,000 "	1,100 "	1,200 "	1,200 "
59	Sutherland Falls	Rutland, Vt	2,666	166.6	1+342	1,000 "	1,000 "	1,100 "	1,200 "	1,200 "

CONGLOMERATES.

60	Conglomerate	Roxbury, Mass	2,708	169.2	1+49	700 Fah.	800 Fah.	900 Fah.	1,000 Fah.	1,000 Fah.
61	Potomac Stone	Point of Rocks, Md	2,724	170.2	1+60	600 "	700 "	800 "	900 "	900 "
62	Conglomerate	Caps a La Aisle, P. Q	2,645	165.3	1+80	600 "	700 "	800 "	900 "	900 "

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Clay Slate.

63	Sabin's Quarry.....	Montpelier, Vt.....	2,869	179.3	1+110	800 Fah.	850 Fah.	900 Fah.	1,000 Fah.	1,209 Fah.

Soapstone.

64	Soapstone.....	Weathersfield, Vt.....	2,668	166.7	1+318	1,200 Fah.	.....	.....	.....	.....

Artificial Stone.

65	Artificial Stone.....	McMurtire & Chamberlain patent.....	2,235	139.7	1+280	750 Fah.	800 Fah.	1,100 Fah.	1,200 Fah.	.....

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I would remark that my experiments with granite show that there is quite a range in their capability of standing heat—a range, in fact, much greater than I anticipated. With the sandstones the difference is also marked as is their power of absorption. When exposed to heat wet they show a marked difference in the time required to heat them, the saturated ones seeming to resist the heat for a time; but when equally hot they crumble the same as those not previously saturated. Their relative worth can be seen by the tables. The conglomerates stand heat badly while the limestones and marbles stand best of all (up to the point where they by continued heat are changed to quicklime), except soapstone, and a species of artificial stone made under the McMurtire & Chamberlain patent.

The indications are from this and other samples that it may be possible to make an artificial stone cheaper and better for fire-proof buildings than our native quarries furnish, and we hope this possibility may receive attention. But comments are useless, as the facts set forth in the tables speak for themselves.

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ON THE MORE IMPORTANT PARASITES OF THE HIGHER ANIMALS.

By G. H. PERKINS, Ph. D., Professor of Zoology in the University of Vermont.

In the "Eighth Annual Report of the Secretary of the Vermont Dairymen's Association," published in 1877, there is an abstract of a lecture by the writer upon "Certain Internal Parasites." Necessarily brief and without illustration, this abstract could do little more than call the attention of those interested in its subject to the leading facts mentioned. The present paper is intended as a more complete, and it is hoped useful, contribution to the subject. Only a conviction of the extreme importance and practical value of the study of parasites and of the intimate connection which is found to exist between their habits and the health, not only of our common domestic animals, but even of man himself, decided me to bring it, as I have, before so many agricultural gatherings. And the more thoroughly the habits and effects of parasites are understood the more important and necessary does their study appear. There is, probably, no group of animals, of equal economical importance, concerning which so little is certainly known by the majority of the community, and yet it requires no more than a quite superficial study of the subject to show very plainly how important it is that a very different state of things should exist. We need only to become aware of the universal prevalence of parasites, at least among the higher animals, and to see how much mischief their presence may, and often does, cause to reach the conclusion that it is necessary for some one to collect all possible information respecting them. Although it is quite possible that one may begin the study of parasites, not because attracted by its own character, but because of some appreciation of the necessity for such study; this feeling does not long continue. As the structure, habits and transformations of the different species come into view disgust speedily gives place to astonishment, wonder, and even delight. I know of no group in the

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entire animal kingdom more strange and interesting in the life-histories of the animals which compose it than that commonly called *Entozoa.*

This very fact, however, explains in part the difficulty of ascertaining the exact truth concerning any of these animals. Their habits are, in many respects, so unlike those of most animals, their changes of location so singular and unexpected, living at different stages of their lives, as many do, now in one part of an animal and now in a different part of another animal, now in pools or streams, and again burrowing in the organs of their host from which they may again escape into the open air, the form changing most remarkably at each change of location, that it is often difficult, or even impossible, to recognize the same species in different stages of its growth. This can be done with certainty only by patiently and laboriously watching every step of the development from the egg to maturity. Inasmuch as a complete and accurate knowledge of the history of any species is essential, if remedies and means of prevention are to be successfully applied, it is obvious that much study and observation must precede their use.

By far the larger number of parasites are simply organized and degraded representatives of the zoological groups to which they belong, and those infesting the higher animals are very much lower in the scale of life than their host. Many of the insects, however, are infested by parasites of equal, or higher, rank than their own. This is true of the parasitic ichneumon flies, a group among the highest in the class of insects, and one to which we owe many thanks for its efficient checking of the increase of various destructive insects. By these insects some very ruinous depredations have been wholly stopped. The common hair worm (*Gordius*) lives during a portion of its existence among the intestines of such insects, as locusts and grasshoppers, and may be beneficial in checking the too rapid increase of those insects. Thus we find that there are parasites which, so far as man is concerned, are beneficial. With these it is not our purpose to deal, but to confine ourselves to the much larger class that are, directly, or indirectly, harmful to man, as all the parasites of domestic animals are. The first and most obvious division of the subject is into "External Parasites" and "Internal Parasites." Some animals may harbor only one of these classes, but most are found to be more or less infested by both and, not infrequently, by large numbers of different sorts. Less important and, because better understood than the entozoa, therefore requiring a less extended discussion, are the

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EXTERNAL PARASITES.

Most of the external parasites of the domestic animals belong to that order of insects known as *Diptera*, a group of which the horse-flies, house-flies, gnats, mosquitoes, etc., may be taken as examples. To this group belong the various species of bot-flies and many so-called ticks and the fleas.

Of the bot-flies full accounts have been given in previous agricultural reports by various authors. They all are stout, hairy flies of which the sheep-bot, figure 1, may be taken as an example.

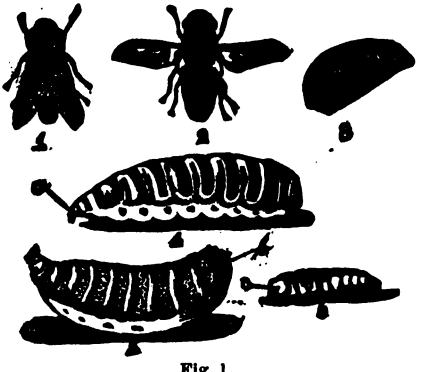

Fig. 1.
ŒESTRUS OVIS—Sheep Bot-Fly.
1, 2, perfect fly.
3, pupa—4, 5, 6, larva.

It is to be noticed that these flies are not parasites except in the larval state and, though usually regarded as external parasites, the horse bot-fly and the sheep bot-fly are really internal parasites so far as their location while parasitic goes; but, as they are very closely allied to other external parasites, and very widely removed from all other internal parasites, it is more convenient to study them with the former group. All bot-flies spend the pupa, or chrysalis, state in the ground and the perfect, or fly, state in the air and, as the mouth parts are but very little developed, they are able to take little, if any, food, their only function being that of reproduction. The ticks belonging to the Diptera are some of them winged, others wingless. They are found, not only upon cattle, but also upon birds and other animals. They are provided with sharp claws by means of which they cling to the hair, feathers, or skin of their host. They all produce one or, at most, two living and full grown larvæ at each brood, instead of laying eggs as most insects do, and yet the broods are so frequent and the young so soon capable of reproduction that they increase with great rapidity.

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Fig. 2. SHEEP-TICK & PUPA.

The horse-tick has two wings and is, in general appearance, somewhat like a house-fly, but the sheep-tick, figure 2, is without wings, and though closely allied to the flies has little of the outward appearance of a fly.

Fleas of various species are found upon different animals. These are wingless and degraded dipterous insects. They often infest buildings, concealing themselves in cracks, or beneath rugs and carpets whence, especially at night, they leap out to attack any unlucky animal that may be in their way. As they are not content with a single bite, but jump about biting as they go, a few fleas may seem like quite an army. The eggs are produced in great numbers and they hatch in about two weeks into white, footless larvæ with bristle-like hairs along the sides. In this state they remain, feeding upon such organic matter as they may find, for a couple of weeks more, when they form cocoons in which they remain inactive for two weeks, or perhaps less, and then they come out as perfect fleas. Different species of fleas appear to prefer each a particular species of animal as, for example, we find one species inhabiting the dog, another the cat, and so on, but, if the favorite sort of animal is not at hand, they do not refuse the blood of some other, or of man. In all the fleas the mouth parts are long and slender, fitted for piercing the skin of any animal they may attack and for sucking the blood which constitutes their food.

Another order of insects, the *Hemiptera*, furnishes several parasites. The bed-bug and lice belong to this group, as does also the common black squash-bug. Lice are degraded members of the group. They all have a wingless, flattened, oval body and a slender piercing proboscis, which they can fold under the body. The head is small, as are the eyes. Different species inhabit different species of animals and sometimes several species are found upon one animal. The bed-bug is parasitic on birds, bats and many other animals besides man, and, on this account, may very readily make its way into houses, where it may conceal itself in crevices or wherever it may find a place. It also hides under the bark of dead trees. An old hunter on the south shore of Lake Superior once told me that on stripping off the bark of dead forest trees he had several times found great numbers of them, and there is no reason to doubt the statement. This insect is tenacious of life,

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a fact which should be remembered when using means for its destruction. It can also live a long time, even a year, without food of any sort.

The true ticks are easily distinguished from those mentioned above by their general form and appearance and they all have eight, instead of six, legs and are classed with mites and spiders. When first hatched the young tick may have only six legs.

Fig. 3.
IXODES BOVIS.
Upper figure natural size; lower enlarged. From Packard's Zoology.

The cattle-tick, (*Ixodes bovis*, Riley,) figure 3, is one of the commonest of the ticks. Its body is oval, covered with a leathery skin of a reddish color. It is a very large species, being sometimes half an inch long. It is chiefly found in the western states.

Another species, (*Ixodes unipictus*, Pack.,) is about half as large as the preceding. It is darker in its general color and bears a whitish spot upon its back. It is found upon various animals, including man. Many other species of ticks are found living upon different animals.

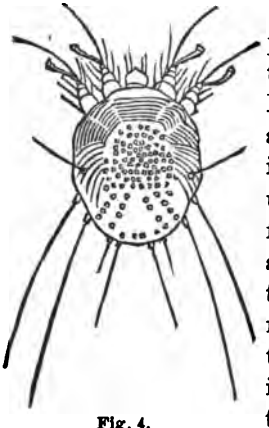

Fig. 4.
SARCOPTES SCABIEI.
Much enlarged. From Verrill.

Mites of various species are common parasites and often produce very serious trouble. One of these, (*Sarcoptes scabiei*, Latr.,) figure 4, produces the disease known as itch in man. It is an exceedingly minute insect of a whitish appearance. It burrows under the skin, making tunnels which at first go directly inwards from the surface and then turn in a horizontal direction. In these burrows the eggs are laid. The burrowing of this insect produces much irritation, itching, and watery pustules caused by inflammation. The pustule usually marks the place at which the insect entered the skin. These mites are generally sluggish, but they are able to jump some distance, and in this way may pass from one person to another.

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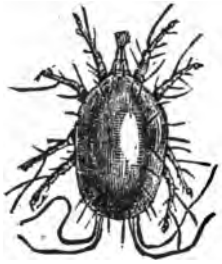

Fig. 5.
TYROGLYPHUS SACCHARI—Sugar mite. Enlarged many times.

Another somewhat singular mite, figure 5, is found in great numbers in some kinds of brown sugar from which it finds its way to the skin of those who handle it, causing what is known as grocer's itch.

Fig. 6.
PSOROPTES EQUI—Mange insect of horse. From Cuvier.

Another mite, figure 6, produces the disease known as mange in horses. Lice, ticks and mites may all be destroyed by similar methods. Perhaps the best general remedy is a solution of carbolic acid, of strength varying with the character of the infested animal and the location of the parasite. Tobacco tea, with the addition of a small amount of carbolic acid, proves efficacious as a remedy for lice and ticks. A solution of sulphuret of potassium in the proportion of from 2 ounces to 4 ounces in a gallon of water is highly recommended; also some authors recommend a wash made by boiling in common whitewash as much flowers of sulphur as can be dissolved, diluting the mixture with water before using it. In any case it is probable that more than a single application of whatever wash is used will be necessary. The second application should be made a week or ten days after the first. Snuff, or Persian insect powder, is useful and may be often used, especially the latter, more conveniently than the liquid remedies. The carbolic acid has an advantage over any other remedy in the persistency of its odor, which is repulsive to most insects. I have known cases in which the hair of animals washed with a solution of this substance retained the characteristic odor for several months, so that when the hair was dampened it could be plainly perceived.

INTERNAL PARASITES OR ENTOZOA.

We now come to the most extensive and important division of our subject, and leaving the consideration of those parasites which live upon animals, we turn to those which spend, at least, a portion of their lives, inside their bodies. They all belong to the zoological group *vermes*, or *worms*, although by no means in all cases worm-like in form. They are all simply organized, often having only a rudimentary, circulatory, respiratory and digestive system. The reproductive system is, however, always highly developed and their in-

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crease often very rapid, though, from the nature of their habitation and the vicissitudes to which they are exposed, comparatively few of those hatched from the egg ever reach maturity. The Entozoa form a group peculiar in many important respects, so much so that, as Cobbold suggests, their study almost constitutes a science by itself. Says Dr. Cobbold in this connection: "The happiest, and perhaps after all the most truly philosophic way of studying the Entozoa is to regard them as a peculiar fauna destined to occupy an equally peculiar territory. That territory is the wide-spread domain of the interior of the bodies of man and animals. Each animal, or "host," may be regarded as a continent, and each part, or viscus, of his body may be noted as a district. Each district has its special attractions for particular parasitic forms; yet at the same time neither the district nor the continent are suitable localities as a permanent resting place for the invader. None of the internal parasites 'continue in one stay;' all have a tendency to roam; migration is the very soul of their prosperity; change of residence the *sine qua non* of their existence, while a blockade in the interior, prolonged beyond the proper period, terminates only in cretification and death." Animals harboring these unwelcome guests may be infested by only a few or by many, and instances are recorded of animals infested by thousands of them. They are always damaging to the health of their host, often causing severe pain and grave disturbances of the organism, and not seldom prove fatal. As will be seen hereafter, man is interested in the study of such parasites as infest those animals which he has domesticated, not only because by their destructive ravages they deprive him of his property, but still more because they may affect his own health and life. As complete a knowledge as may be possible of the habits of these parasites is the more important, because it has almost always been found that prevention is much more easily accomplished than cure. Indeed, it is very often, if not usually, true that, while the presence of parasites can be prevented successfully, when they have once gained admission into the system of an animal they cannot be expelled without danger, and must be left to work out their own course as determined by the laws of their development, even though this should involve the destruction of the host. A group composed of animals possessing such diverse characteristics and so numerous as the Entozoa is necessarily unwieldy when considered as a whole, and it has been found convenient to separate it into several divisions. The whole group may, for our present purpose, be divided into *Platyhelminthes* and *Nematelminthes*. The *Platyhelminthes*, or flat worms, are more or less

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ribbon-like worms of variable lengths. Some have a very much branched digestive tube, others none at all. The *Nematelminthes* are round worms and are usually somewhat more complex in their organization than the *Platyhelminthes*. The *Platyhelminthes* are again divided into three groups, viz.: 1. *Turbellaria*. 2. *Trematoda*. 3. *Cestoda*.

The *Turbellaria* are flat worms, of ovate form; the outside of the body is covered with fine hairs or cilia. They are mostly non-parasitic, and none of them, I believe, are found in man or domestic animals. The *Trematoda* are also flat, ovate worms, with one or more suckers on the lower side of the body. They are, in their adult life, parasitic in the higher animals. In the immature stages they live in water or on snails. The largest are several inches long, while the smallest may not be more than one hundredth of an inch long. The life histories of but few of the *Trematoda* are known. They all pass through several transformations, if we may judge the whole group by those whose history is known.

The most common Trematode parasite is that known as the *Liver Fluke* (*Fasciola hepatica*, Linn.) The general form of this parasite may be seen in the cut, figure 7.

Fig. 7. FASCIOLA HEPATICA —Liver Fluke. About twice natural size.

It is found in sheep, cattle and other animals, and rarely in man. As the figure shows, the form is ovate, the anterior end being widest. The length is from three-fourths inch to one and one-fourth inch, and the width from one-half inch to three-fourths inch. Its color is light brown, or greenish yellow. If disturbed they often curl up the ends of the body. In front is a cup-shaped sucker which surrounds the mouth and back of this, near the widest part of the body, is a second larger sucker. The surface appears smooth to the naked eye, but if it be magnified it is seen to be covered with small spines, though, as these are easily rubbed off, they may not be always present. The reproductive system is, as in most Entozoa, greatly developed and the animal may produce a great number of eggs. The digestive system is also well-developed. The eggs pass out from the infested animal and such of them as reach water, or any damp place, hatch, after a time, into small embryos of a conical form, covered with hair-like filaments or cilia, by the vibration of which they swim freely. After a time they probably find their way to some water snail upon which they become parasitic, the cilia having been lost by this time

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so that the embryos must creep instead of, as before, swimming. Soon, it is most probable, this embryo works its way into the snail where it changes its form and becomes larger and sac like. Inside of this sac new larvæ are developed. These larvæ (or when free from the sac, *Cercariæ*, as they are called, the sac mass itself being called a nurse,) are much more active than the unciliated embryos. They wander from the snail upon which they have been living and may be swallowed by sheep or cattle, either in water drank or upon moist grass. In this way the cercariæ find their way into the stomachs of the animals in which they are found, and from there pass into the intestine. At this time each has somewhat of the form of a tadpole, but as it reaches the intestine and makes its way to the liver it loses its tail—burrows out a small space and becomes encased in a shell of lime, and in time, it may be several months, it develops into a mature fluke. They may exist in large numbers in the liver of a single sheep and each fluke may contain many eggs, which, when freed, pass from the intestine and, if they reach a favorable location, they hatch and pass through the series of changes already indicated. It may be stated that all of the stages indicated above have not been traced in the species under consideration, but uniting such facts as have been observed with those observed in allied species, the course of development indicated is so probable that we may regard it as almost certain. After it has become sexually mature the fluke voluntarily leaves the liver and passes from the intestine full of eggs, which may hatch or perish, according to circumstances, and the fluke itself speedily dies. As has been seen, the development of this parasite can only take place in the water, hence only those eggs that reach some pool or stream can develop. The *Fasciola hepatica* is found in many animals, but is most abundant in those that graze. In the Adirondacks deer are sometimes killed whose livers are filled with flukes, probably of this species. The presence of *Fasciola* in sheep, if in considerable numbers, causes the disease known as "rot" or "fluke-rot," which must not be confounded with the "foot-rot." It has been thus far much more prevalent and destructive in Europe than in America. In some parts of England and the continent the loss has been very great. Thus, Leuckart states that "in the neighborhood of Arles alone, during the year 1812, no less than 300,000 sheep perished. In the inner departments, during the epidemic of the years 1853–54, many cattle breeders lost a fourth, a third and even three-fourths of their flocks." And Cobbold says that "Scores of cases are on record where our English farmers have individually lost three, four, five,

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and even eight hundred sheep in a single season; and many agriculturists have thus become completely ruined"

The outbreaks of "rot" in Europe seem to occur periodically, at intervals of several years. But while this trouble has not developed in this country to any such alarming extent as in Europe, it is not unknown here, and several cases, one or two involving considerable loss, have come to my knowledge in Vermont, and I am certain that loss from this cause is more common than may be supposed from the fact that more than one case of death among sheep from unknown causes has been related to me by farmers, which was probably due to this parasite. Because I have found that, although the fluke has been known for many years in Europe, and even in America, there are many intelligent farmers who fail to recognize its presence, and because it is very important that its presence should be at once known, I shall give the indications of flukes in the liver of sheep with some fulness of detail. If the flukes have established themselves in large numbers in the liver and have been there for some time, their presence may be readily and surely known by the appearance of the animal. Cobbold speaks of the weakness over the loins of the sheep, where a slight pressure of the hand "immediately causes him to wince, at the same time there is communicated to the hand a yielding sensation totally unlike the firm resistance one meets with when running the hand down the spine of a sound sheep." If the case is a very bad one there is a noticeable hollowness of the back. The skin, too, loses its ruddy hue and becomes deficient of the unctuous secretion which in health belongs to it. This renders the wool harsh and dry, and leads also to its easy separation from the follicles. A dry, scaly state of the skin on the inner parts of the thighs, particularly where it is uncovered with either wool or hair, is likewise early to be recognized." "An examination of the eye will materially assist in determining the question of disease. If the lids are everted, the membrana nictitans being pressed forward, it will be found in the early stages of the malady, and especially if the animal has been excited by being driven a short distance, that the vessels of the conjunctiva are tinged with pale or yellowish colored blood and the whole part has a peculiar moist or watery appearance. Later on the same vessels are blanched and scarcely to be recognized, excepting, perhaps, one or two, which present a similar watery condition or are tinged with dark colored blood." If an animal diseased in this way be cut up, all the tissues are very watery and flabby and pale and especially do the contents of the abdomen present a pale appearance and the cavity contains a yellowish, clear fluid. The

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liver has not the usual dark color, and smooth, even surface, but is nodulous and uneven, and of a dirty brown or yellowish. In the bile ducts the flukes may be found in greater or lesser numbers, sometimes several hundreds.

As for treatment, it may be seen from what has been shown as to the development of the parasite, that sheep pastured in dry pastures will be less likely to be infested than others and even sheep kept on low ground may be kept free if they are well cared for and fed hay or roots from dry ground. When once in the body of the sheep it does not seem practicable to expel them. Affected animals should be at once put in a dry location and fed well with good nutritious food and kept in as good a condition as possible. Most authorities consider salt as of use.

Cobbold says that the fluke is especially prevalent during the spring in its mature state, and that at this time it escapes frequently from the alimentary canal. Also large numbers of eggs may be discharged from infested sheep and these eggs may be dispersed hither and thither by winds and such as reach any body of water may develop—indeed, the egg before passing from the body of the fluke has so far developed as to contain a ciliated embryo which is able, as soon as set free from the shell of the egg, to swim freely about and the development goes on as already described. Although not a common human parasite, this Fasciola is not to be passed by as of no direct interest, aside from a pecuniary one, to man. Mature, or nearly so, larvæ, the cercariæ, find their way into the skin of man and in this way become lodged in his system. Man may also swallow the larvæ in water, or on vegetables. In both cases, if the parasites reach the liver, serious consequences may follow. Celery, or other vegetables, that grow near pools or ditches, or that are watered from such places may conceal fluke larvæ and are safe to use only after thorough washing. When once the fluke has established itself in the system its presence could be rarely determined with certainty and if it could, no methods are as yet known by which it could be dislodged.

In another way man may receive damage from the fluke. The remarks of Dr. Cobbold in relation to this are so eminently practical that I quote them at some length. "Though of comparatively rare occurrence in the human body, the common liver fluke is, in an indirect manner, extremely injurious to man. By its prevalence in the lower animals it cuts off a large supply of healthy food, at the same time producing a quantity of meat unfit for the market, but which, nevertheless, is largely eaten by our poorer inhabitants. Even the

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odor arising from the diseased condition of the animal flesh is not without its baneful effects and in one instance, at least, it appears to have been the immediate cause of death. In the summer of 1854, says Mr. Simonds, 'a person of intemperate habits, following the occupation of a country butcher, was employed in skinning and dressing a number of rotten sheep on the premises of a farmer in the county of Norfolk. The sheep were necessarily opened when warm and while he was so engaged he complained greatly of the sickening smell. The same evening he was attacked with choleraic disease and two days afterwards was a corpse.'"

Another of the flukes is that known as

DISTOMA LANCEOLATUM, Mehl.

This is also found in the bile duct and gall bladder of cattle and rarely of man. It is smaller than the preceding, being only about one-third of an inch long and about one-eighth of an inch wide. The body is thin, flat, smooth, lanceolate in outline, widest just back of the middle, whence it tapers towards each end. Its development is not greatly different from that of Fasciola. In its effects it resembles the preceding species but its smaller size prevents it from doing so great injury and so far as I can ascertain it never has caused any very serious mischief. Several other flukes have been found in the human system, though rarely. One species, however, (*Bilharzia hæmatobia*, Cobb), has proved a serious pest at the Cape of Good Hope, where its presence in the portal vein and in adjacent blood vessels has given rise to a common and dangerous disease. There are also several flukes found in the paunch of herbivorous animals, where they live attached by suckers to the lining membrane. They are more cylindrical than the liver flukes and do not so far as is known, do any especial harm. They belong to the genus *Amphistoma*. They are supposed to pass through the same, or similar, stages of development to those of Fasciola, and to be introduced into the stomach in drinking water.

CESTODA.

The third group of the *Platyhelminthes*, the *Cestoda*, is of even greater importance than the former, embracing as it does a far larger number of injurious species, some of which are common in man and sometimes produce disorders in his system of a most terrible sort. As will be seen, the history of these animals, commonly known as tape-worms, is exceedingly strange and interesting. In form they differ much from the *Trematoda*. Like them they are

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thin and flat, but, while the *Trematoda* are short and unjointed, these are usually long and composed of many joints, though some have but few. In general they are flat, ribbon-like worms, with soft, semi-transparent bodies. There is a more or less globular head, which has suckers by which the animal may cling to the intestine, or wherever it may be located. Sometimes, but not always, there is a crown of hooks about the head. The worms comprised in this group have a very simple organization, having no digestive apparatus and very little complexity of structure. When the animal is mature each joint has the power of independent life and of producing great numbers of fertile eggs, and as these joints drop off, one after another, they pass from the animal and may scatter the eggs wherever they may happen to be. So complete are the joints, each in itself, that some authors regard a tape-worm, not as a single individual, but as a community. But it is certain that the welfare of this colony depends largely upon the condition of the head and if this be destroyed the whole ultimately perishes. In some cases a single egg may produce more than one tape-worm, though this is not usual. All the cestodes pass through great metamorphoses during their development. As will be shown hereafter, in all cases the worms live in an embryo condition in one animal and in an adult in another which feeds upon it and, in an intermediate state, only for a very short time, however, it lives outside of all animals. Tape-worms are found especially in the higher animals and several species may exist in one animal; ten are known to exist in the human system. A few invertebrates also harbor tape worms. The development of one of the tape-worms infesting the dog has been experimentally studied as follows: Several mature joints from the dog were given to rabbits which were afterwards killed and examined and, if only a short time had elapsed since the joints were taken, the blood in the abdominal veins was found full of very minute embryo tape-worms and there were found to be hooks about the head with which they could bore through the walls of the stomach or any other part of the intestines. Later, about four days after the joints are taken, small white spots are seen in the liver, which are about one-eightieth of an inch in diameter. These spots increase in size, become oval in form and soon they are large enough to be seen with the naked eye, and this process goes on for several weeks at the end of which time, usually about three or four weeks, the worms become enveloped in a calcareous shell, or box, and escape into the abdomen, where they wander about for a time. Later they become encased in another cyst and this is as far as they will ever develop in the rabbit; but, if

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a portion of this animal be swallowed by a dog, the cyst dissolves and the embryo worm develops into a complete, many jointed tape-worm. The most common tape-worm of man, the pork tape-worm, *Tænia solium*, develops in much the same manner, and thus we find this strange relation existing between one animal and another, between the animal which serves as food and that which devours it. This relation is shown in the following list, which might be indefinitely extended:

MATURE OR CESTOID FORM.	YOUNG OR CYSTIC FORM.
Tænia solium is found in man,	Found in muscles of the hog.
Tænia mediocanellata is found in man,	Found in muscles of cattle.
Tænia echinococcus is found in dog,	Found in organs of man and cattle.
Tænia cœnurus is found in dog,	Found in brain of sheep.
Tænia crassicolis is found in cat,	Found in brain of rats and mice.
Tænia serrata is found in dog and fox,	Found in liver of rabbit.
Tænia cucumerina is found in dog,	Found in dog louse.

In this last case we have a singular development, for, while the mature worm lives in the intestines of the dog from which the eggs pass, these eggs are eaten by the louse, in which they develop into minute, sexless tape-worms, and in this state being swallowed with the louse by the dog, develop in his body into sexually mature tape-worms. In fishes and amphibia are to be found the immature forms of tape-worms, which become mature in the intestines of water birds and one species found in man is supposed to originate in fish. We will now study a few of the tape-worms, those that are most liable to infest man, as fully as the space at our command will allow. We have first to consider

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Fig. 8.
TÆNIA SOLIUM.
Natural size. The three upper right hand figures show the head enlarged and in different positions

TÆNIA SOLIUM, Linn.—*The common tape worm of man*, figure 8.—Probably no Entozoa has been more satisfactorily studied than this. The parasite is often very long, flat jointed, whitish, tapering to a very slender thread-like portion at one end, terminating which is the globular head, which is usually about as large as the head of a large pin. This bears four suckers, some of which are seen in the figure, on the enlarged portion of the heads on the right side of the cut. The upper part of the head is bluntly conical and is surrounded by two rows of hooks (from 22 to 28 in each row). This tape worm may be many feet long and the largest joints are usually about one-third of an inch wide and rather more tham one-half inch long. The narrow portion next the head is not jointed, but is crossed by a great number of fine lines; after this comes an indefinite number of joints. According to Leuckhart the first 450 joints do not produce fertile eggs, but all after this are furnished with sexual organs and each is capable of producing multitudes of fertile eggs. Often but one worm exists in the body, but there may be several, and, in rare instances, thirty or forty, and it is thought by some authorities that the cases of worms several hundreds of feet long which have been reported were not simple worms, but several counted as one. Cobbold doubts if a single Tænia solium ever reaches a greater length than thirty feet. As joints become mature and filled with eggs they drop off and pass from the intestine and thus a person infested with a tape-worm becomes involuntarily a disseminator of the parasite. The joints are able to live some time after escaping from the body and they can even move somewhat and as the embryos in the eggs grow it swells and finally the covering bursts, thus liberating the eggs. If these ova are swallowed by a pig they of course

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pass into the stomach and the shells are there dissolved, setting free the minute embryos, which are at this time bag-like at the posterior end with a short neck terminated by a globular head which is furnished with an apparatus for boring, and, as soon as set free, they begin to work into the tissues of their host and lodge in the fatty portions of the muscles, or in some organ. Here the hooks are lost and the animal becomes encased in a calcareous shell in which it is coiled. If the larvæ make their way into a blood vessel they may be carried to any part of the body. Before becoming quiescent in the organ or muscle in which they have lodged they burrow about for a time and cause inflammation and if in large numbers great disturbance. But this inflammation causes the cysts, or cases of calcareous matter, to be formed about the embryo and when these are formed they no longer move about and the part infested becomes spotted with white places, or becomes what is popularly called "measly." The inflammation now subsides and the animal infested may be, to all appearance, perfectly well. When fully formed the measle of this worm is an oval, or bean shaped, whitish body, about one-thirtieth of an inch in diameter and hence visible to the unaided eye, if present in any considerable numbers. The measles retain their vitality for some time after the death of the animal in which they have existed. If any one, or more, of the cysts formed in measly pork be eaten by man, the cyst, or shell, is dissolved in the stomach and the embryo uncoils and forms a minute worm, consisting of a head with four suckers, a crown of hooks and a narrow portion of some length ending in a sac of globular or ovoid form. When it reaches the alimentary canal it firmly attaches itself by its suckers, and, by a sort of budding, joint after joint is formed until a tape-worm mature in all respects is produced, and thus its history is complete. The presence of one or more of these tape-worms in the human intestine produces a great variety of disorders and symptoms, so that it is not easy for a physician to determine its presence or be certain of the cause of the trouble unless the joints, that are liable to pass off at any time, be discovered. This of course discloses the presence of one or more of the parasites. I do not know that there are any symptoms caused by the presence of a tape-worm which are not also symptoms of other disorders. The effects are sometimes not grave, but often they are severe and taxing to the system, and many disorders, as colic, vertigo, dyspepsia, lassitude, es-

Fig. 9.
LARVAL TAPE WORM.

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pecially in the limbs, faintness at times, hysteria, epilepsy, convulsions and even insanity have all been caused by the presence of this parasite and have been completely cured when it was removed. Fortunately, if a correct diagnosis of the case can be reached, there are remedies which are almost certain. It would be out of the province of this paper to enumerate them here, but it will be sufficient to say that oil of male fern seems best, though turpentine has been used with very good effect, and mush of pumpkin seeds, and other remedies less certain, but sometimes sufficient, have been successfully used. In any case the remedy should be taken under the direction of a physician. I have shown that in all cases two distinct animals are needed for the full development of the tape-worm. In exceptional cases, however, the development may be carried on in one alone, as when man swallows the eggs of Tænia solium they may develop embryos and make his flesh "measly," but the development will go no farther than this. However, its presence as a cysticercus, or embryo, is more fatal than as an adult worm. As this tape worm can reach the human system only from "measly" pork, it is important that this should be avoided, and, as in cases where only a few exist they are not noticeable, it is important that no pork, not thoroughly cooked, should be eaten. In pork well cooked, or salted, the heat, or brine, destroys the embryos. Raw ham, sausages and the like may be prolific sources of this parasite and should be avoided accordingly. It is also obvious that, as the hog becomes infested by swallowing eggs that have passed from the intestines of their human hosts, these filthy beasts should never have access to human excrement.

Not so commonly found in man as the preceding, but yet not very uncommon is

Fig. 10. Head of TÆNIA MEDIOCANELLATA—Beef Tape worm. Enlarged.

TÆNIA MEDIOCANELLATA, Kuch.—*The Beef Tape-worm.* This closely resembles the pork tape-worm and is often confounded with it. It lacks the crown of hooks which the latter possesses and the head is not pointed at the end. Its form is seen in figure 10. The changes in form and location are like those of the preceding species, the calf giving place to the hog, as the source. "Measly" veal is, perhaps, more dangerous than measly pork, because the "measles" are much smaller and hence less easily discovered. The mature worm is much larger than Tænia solium. Uncooked veal, or beef, is to be avoided, as being a probable source of this parasite. Its effects appear to be identical with those of Tænia solium and the same remedies should be used.

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There are several other tape-worms of small size and rare occurrence that infest the human body in the mature state. There are, however, several others that infest man in the immature condition.

Fig. 11.
Head of TÆNIA MARGINATA (mature.)
Much enlarged.

Fig. 12.
Embryo of TÆNIA MARGINATA—Diving bladder-worm. From Verrill.

TÆNIA MARGINATA, Batsch.—This is best known as the diving bladder worm of sheep and cattle. As a bladder worm it is in its embryo condition. It may be found in various parts of the body, but most frequently in the viscera. The head is small and bears suckers and a row of small hooks; below these is the neck, made up of many very short joints, figure 12, and finally there is an immense sac, or bladder, sometimes five inches long, of a globular or pear shape. The upper part of this is slit and into it the head and neck can be withdrawn with a very peculiar movement, regular as a pulsation, as they rise and fall in the fluid of the sac. The mature worms may exist in the dog in large numbers and are by them propagated, as joints full of eggs pass from the intestine, and in this way the eggs escaping may be blown into water, or over grass, and thus sheep and cattle take them and as they reach the stomach they hatch and find their way to various parts of the body where they develop into the water bladders, or diving bladder worms. By pressure upon organs, or inflammation which they cause in them, great mischief is often done. While the young worms may be carried to any part of the body and may lodge there and cause serious inflammation, all soon perish except those that go to the liver, or viscera, and these only form the bladders. It seems to be very common in England. It has been stated on high authority that nearly every sheep killed in, or near, London has these bladder worms and, as a corollary, most of the butcher's dogs have the mature worms, for, if a dog eats the flesh of an infested animal and swallows one of the bladder worms the result is always the growth of a mature tape-worm. It does not live in the human system in the mature state and only in

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very great rarity in the cysticercus state. It will readily be seen that dogs are able to do great mischief by involuntarily increasing the spread of this parasite, for, if a dog devours the bladder worms which he may find about a slaughter house, and these develop into mature worms which produce eggs, these will pass from the dog and be scattered where sheep may swallow them, and when an animal is once infested it does not seem possible to remove the parasite. The size of the "water bladders is so great that by simple pressure upon the adjacent organs great harm may be done." The adult worm is somewhat like the pork tape-worm in appearance, but is smaller. Another tape-worm also found in dogs in the adult shape, but infesting sheep in the cysticercus state is

TÆNIA CŒNURUS, Kuch.—This is also found in the immature state in cattle, horses, goats and some other animals, but it is most common in the sheep, causing the disease known as "water-brain," "gid," "staggers." The ova, scattered from the fæces of dogs, find their way into the stomachs of sheep and are borne by the circulation to various parts of the system, but only those that reach the brain appear to develop. Having reached this organ they burrow in its substance as shown in figure 13, A,

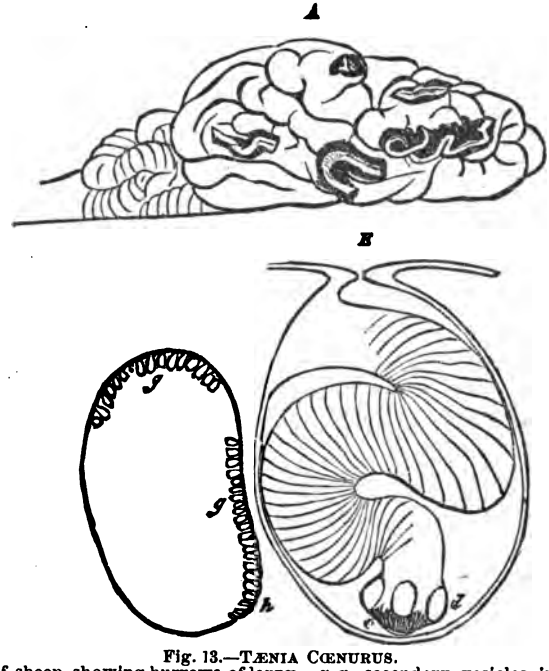

Fig. 13.—TÆNIA CŒNURUS.
A, brain of sheep showing burrows of larvæ, g g, secondary vesicles inside a large primary vesicle. E, one of these greatly magnified, showing the contained embryo. d, suckers about the head. c, crown of hooks. From Packard's Zoology.

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and form soft, white, transparent tumors of oval or spherical form, and ultimately cause death. On the outer surface of these tumors are great numbers of little elevations. These are the heads of minute tape-worms, which may be one-sixth inch long when fully extended. Each of these little heads is furnished with a pointed, beak-like protuberance on the front of the head, and with four large suckers, figure 13, E, d, and a crown of hooks, figure 13, E, c, which are in a double row. They increase in number after they have located themselves in the brain, by budding, so that from one there may in time come a large number. The symptoms of their presence vary greatly. A sheep thus affected has at the outset a wandering, dull gait, "which is frequently succeeded by irregular, tortuous, whirling movements of the body, accompanied by contortions. A simple, temporary cure is readily affected by puncturing the head over the diseased part, but very commonly the animals die of exhaustion and inability to take their proper amount of food. In the later stages of the disease, especially where several tumors exist in the same brain, it is not uncommon to find the skull thinned out in various directions. In many places the bony absorption is complete, so that the skull exhibits on being dried, a perforated and irregularly honey-combed appearance." If a dog is at hand when a sheep having these hydatids is killed and gnaws a part of the skull and swallows some of the young worms, they reach the stomach and there lose their calcareous envelope and reaching the intestine fasten themselves there and become small tape-worms and, as joint after joint passes off from the dog, the eggs are scattered about, as already noticed, and as they retain their vitality for a long time, may be taken into the stomach with water or herbage. Of course the dogs become infested by swallowing the embryos which they find in skulls about slaughter houses. Hence one of the most effectual methods of preventing the increase of this, as well as the preceding species of tape-worm, is to diminish the number of dogs and to prevent such as are kept from prowling about slaughter houses, feasting upon such offal as they may find. We now come to the study of a tape-worm of which Cobbold says that it "is probably more injurious to the human race than all the other species of Entozoa put together, or, to say the least, it is more frequently the immediate cause of death than any other internal parasite." This is *Tœnia echinococcus*, Siebold. The mature worm, figure 14, is found only in the dog and wolf.

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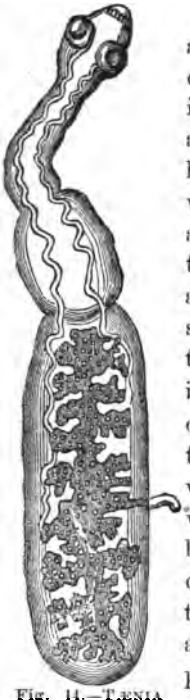

Fig. 14.—TÆNIA ECHINOCCUS. Very much magnified.—From Van Beneden.

It is very small, being when fully grown only about one-fourth inch long, and often less, and is composed of but four joints. It may exist in the intestines of the above animals in great numbers, and the larvæ form what are known as hydatids and hydatid tumors in various parts of the human body, which cause very grave disorders. These hydatids are also found in sheep, cattle, horses and pigs though much more commonly in sheep than in other animals. The eggs, to the number of several thousand, develop in the last joint, which separates from the rest and passes from the intestines of the dog into the open air. Here, by the bursting of the skin of the joint, the minute ova are free to be blown by the wind or carried in various ways into drinking water, or scattered upon vegetables or fruit, and with these articles make their way into the human body. In each of these eggs an embryo like that of other tape-worms, is developed and this, freed from the imprisoning envelope by the fluids of the stomach, makes its way over the body. This embryo appears to have a special liking for the liver, but may go anywhere, and wherever they are located they soon begin to burrow into the substance of the part and, in time, are transformed into the bladder-like masses called hydatids, fig. 15.

Fig. 15.—Hydatid Cyst of TÆNIA ECHINOCCOCUS.

Thus far the development of this tape-worm is analogous with that of others, but now a series of changes begin which are unlike any observed in other species. Most tape-worms develop a head and neck which terminates below in a more or less globular sac; but this parasite does not become elongated, but is always, while in the cysticercus state, more or less globular. It is very small. "At the fourth week the echinococcus capsule measures about the one-twenty-fifth of an inch in length, its contained hydatid being little more than half of this diameter. Its subsequent growth is by no means rapid, seeing that at the eighth week the hydatid has attained only the one-fifteenth of an inch or thereabouts." (Cobbold.) Later the growth is much more rapid and tumors of considerable size may be produced. They vary in form in

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different animals, but all ultimately develop, unless prematurely destroyed, into identically the same mature form. Cobbold says: "In the lower animals hydatids generally occur in the form of single, globular, or lobulated cysts, varying in size from a walnut to that of the egg of a goose. Usually there are several cysts occupying the same organ, or, not infrequently, several organs in the same bearer." In man a more complex form of hydatid cyst is often found. Ordinarily a tumor of this sort when first removed from the body, is a thin sac, enclosing what appears to be a watery fluid of a yellow or amber color. The envelope or sac is composed of two distinct membranes, the outer thick and elastic, the inner "thin, soft, granulated and comparatively inelastic." On the inner surface of this membrane very slight elevations appear, and their increase in size ultimately show embryo heads, or they may not develop so far as this, but become oval capsules inside of which several heads may be finally formed, the original capsule being destroyed in the process. Many, or all, of these may become true embryos and develop in suitable circumstances into mature tape-worms, but usually some of them, by a sort of budding, develop each many other, or secondary, cysts, and these secondary or "daughter" cysts, figure 16, may some of them again give rise to tertiary or "granddaughter" cysts. In this way the minute hydatid may develop until a tumor several inches in diameter is produced. The budding may take place on the outside and produce a collection of cysts, each of which may in turn form another group, or, it may be internal, the secondary cysts forming inside of the primary and the tertiary inside of these. To the inner walls of one of these cysts small oval bodies are attached which when sufficiently magnified are seen to be heads of the embryo tape-worm, figure 17.

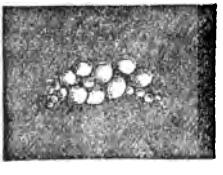

Fig. 16.
Daughter or secondary cysts of TÆNIA ECHINOCOCCUS. From Cobbold.

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Fig. 17.
TÆNIA ECHINOCOCCUS embryos, showing manner of budding on the inside of a hydatid tumor.

These heads may form on the outer surface of the cysts and each of them may be changed into brood capsules in which by budding other heads may be formed, figure 18, and to the same membrane side by side may be attached heads and brood capsules. If one of the heads, as shown in figures 17 and 18, be carefully examined it will be found to be a sac in which the head, instead of being directed outwards, is, as has been noticed, turned in like the inverted finger of a glove, though this is not invariably the case. After a hydatid tumor has been removed from the body of an animal multitudes of these minute heads are to be seen floating in its watery contents, but it is supposed that none are thus free during life.

Fig. 18.
Embryo of TÆNIA ECHINOCOCCUS budding.

If any of these heads be swallowed by a dog it is capable of developing into the mature tape-worm, which may produce thousands of eggs which the dog may scatter anywhere with his excrement, and only by this means is this terrible parasite disseminated and introduced into the human system. That the parasite is terrible in its effects the following facts make sufficiently plain. As has been seen, it most frequently attacks the liver, but it is not uncommonly found in other organs, and its presence anywhere in the body is generally fatal, this result being brought about more or less speedily according to the location and number of the parasites. Sometimes a hydatid tumor bursts spontaneously and thus a natural cure is effected, but this is very seldom the case. Rarely it is so located

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that it may be removed by a surgical operation. Opening the tumor and allowing its contents to escape seems to effect the destruction of the parasites, but it is important that the cysts, or heads, none of them, find lodgment in the body of the host, for, if they do, it is probable that new tumors will be formed and the evil become speedily worse than before. It is a sad fact that but few cases, which form only a very small percentage of the whole number, have been cured, death being the result in by far the larger number of cases, and it is an understood fact that several hundred persons in this country and Europe die annually from this source, though the cause of death may be supposed in many cases to be something else, as not every physician is able to detect the true source of trouble in cases of hydatids, and sometimes the symptoms are very much obscured by other disturbances which their presence has caused, and which are so conspicuous as to conceal from any but the closest and most experienced observers the presence of the parasites, and often even from them. It is exceedingly probable that, as our knowledge of both the parasites and their effects increases, new remedies will be discovered and some of the terrors of the hydatid disease will be removed. The source of all the trouble is found primarily indeed, in the tape-worms, but, as these live in the mature state in dogs, it is by means of these animals that the disease is perpetuated and spread. Some very striking facts show the relation of dogs to this disease. In Iceland it is stated that there are six dogs, on the average, to each peasant and that these live on very intimate terms with the people. The drinking water is much exposed, and the general habits of the people are uncleanly, and there are, it is stated, at times 10,000 persons under treatment for the hydatid disease, though the whole population is but little more than 60,000, while in other countries, where dogs are less abundant, the number of such cases is very much less. I do not mean to say that the entire difference between one country and another in the frequency of *Tænia Echinococcus*, or hydatids, is due to a difference in the number of dogs, but it is probable, that while cleanliness and general habits of life have something to do with the prevalence of the disease, the presence or absence of dogs has a great deal more to do with it, and it appears certain that if dogs were utterly banished from society, hydatids would also disappear. Prof. Verrill says in this connection, in a paper in the Connecticut Agricultural Report for 1869, "that large numbers of human beings of all ages and conditions, die annually from diseases caused by this parasite, is established beyond a doubt. And although such diseases are most common among the

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poorer classes of society, and especially among those who associate most familiarly with dogs, they are by no means confined to them. Many men of great eminence and talent have likewise perished from the same cause, and, unfortunately, society is so constituted that no one can be certain of escaping so long as the parasites that produce the eggs exist in the dogs of every country. It is estimated that five hundred persons die annually by this parasite, in Great Britain."

While it is true of most parasites that prevention is more easily accomplished than cure, it is so especially of the species under consideration. As this is a matter which concerns every one it is the more important that what is known respecting it should be widely known. We have seen that the "water bladders" and "water brain" of sheep originate in dogs and also that the far more dangerous and terrible hydatids also come from these animals. It is from no hostility to dogs, nor from any desire to excite interest by presenting that which is sensational that I have written the history of these parasites, but because it has seemed to me that most of those who have to do with dogs exhibit a carelessness respecting their condition that, in view of the facts here presented, amounts almost to criminality. Dogs are far more dangerous to sheep because liable to infest them with destructive parasites than because of a taste for fresh mutton which they may possess, and they are far more dangerous to man as the source of hydatids than as the source of hydrophobia, for a much greater number of persons perish from the former than from the latter. While the number of dogs should be kept within bounds, it is not necessary that we should plead for the utter extermination of the race, though, from a sanitary point of view, it is unquestionably true that the fewer dogs there are the better. If, however, those dogs that are of any use in the world, and on this account entitled to live in it, are carefully kept, their presence may not be fraught with much danger. They should be kept rigidly away from slaughter houses and carcasses of animals and thus prevented from acquiring the parasite. If, as is quite likely, this rule cannot be fully carried out, the animals might be treated once in a while to a dose of some anthelmintic medicine in which case all excreta should be carefully disposed of. If to the duties of sanitary inspectors and health officers some of these just mentioned were added and faithfully performed it would be a cause for congratulation. But few of these officials ever think of these things and often, perhaps generally, have little power to enforce such changes in the care and condition of dogs as may be necessary.

In this connection Cobbold lays down the following importan[t]

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rule: "All Entozoa which are not preserved for scientific investigation or experiment, should be thoroughly destroyed by fire when practicable and under no circumstances whatever should they be thrown aside as harmless refuse." He adds: "In the case of Tænia echinococcus the greatest difficulty likely to be experienced lies in the fact of the extreme smallness of the tape worm. As an additional security, therefore, I would recommend that boiling water be occasionally thrown over the floor of all kennels where dogs are kept, for in this way, not only the escaped tape-worms, but also the little free embryos themselves would be effectually destroyed." As dogs do not always remain in their kennels, but roam about, usually wherever they will, water that is exposed to the air should be regarded as unsafe for drink, and should not be taken unfiltered and better if it were boiled before use. I am inclined to believe that if all our drinking water were boiled and filtered very much suffering and disease would be avoided. I doubt if any less efficient means than a very good filter would remove so minute bodies as the very minute ova of this tape-worm. Probably no water is so safe for drinking as filtered cistern water, provided the cistern be in good order. It must be remembered that the eggs of this and other parasites are at all times liable to be blown into exposed water and on this account water from open springs, wells, ponds, &c., can never be safely used before filtering. Such fallen fruits and vegetables as may be eaten uncooked should always be carefully washed. This is not the place to speak of the medical treatment of hydatids, but a few words quoted from Cobbold may be of value to any physician who may read these pages. "One need say little as to the methods of detecting the presence of hydatids. Only a comparatively few cases are known where the diagnosis has been effected with absolute certainty. No doubt the presence of a fluctuating tumor, without concomitant inflammatory symptoms, especially if it be seated in the region of the liver, together with the circumstance of its slow growth, unattended with any particular degree of functional disturbance, would, to most minds, suggest the possible and probable presence of one or more hydatid cysts. Generally speaking, the accidental discharge, or the escape of one or more cysts after incision, constitutes the only absolutely certain diognostic symptom. As regards their treatment,—supposing a satisfactory diagnosis to have been accomplished—this, of course, in ninety-nine cases out of every hundred, has reference to the speedy evacuation of the contents of the tumor. * * * * I may say in the words of Dr. Todd, that 'I know of no cure for hydatids but the evacuation of them. There

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is a popular notion that salt will kill the hydatid. Iodide of potassium has also been frequently tried, but I have never seen any real benefit from the use of these remedies.' To this may be added that the employment of a trochar for the evacuation of the hydatid contents and the subsequent injection of iodine, is a plan which has several times proved successful." For further information as to means and methods of treatment, those interested are referred to a work which has not, I believe, been translated into English, "*Traite des Entazoares, et des Maladies Vermineuses*," C. Davaine, Paris, 1860. I know of no work which can take the place of this for the use of the practicing physician. The horse seems to be especially favored in the matter of parasites. It is infested by several species of tape-worms, but they are all small and do not, so far as I know, commit any great ravages. With this our discussion of the Platyhelminthes closes, and we next take up the

NEMATELMINTHES.—This differs from the preceding group in that the worms it includes are not flat, but round, or thread-like. Not all are parasites; some swim about in the water, or live beneath stones or other sheltering objects just above low tide mark on the sea shore; others in damp earth or in fresh water. Many, however, spend, at least a part of their lives, as parasites in various portions of the body of some animal. They nearly all have a mouth and digestive system. The body is not generally divided into joints and its surface, which is somewhat hard, is usually smooth. The sexes are generally not united in the same individual as in the tape-worms, but distinct. They are mostly small worms, one or two inches in length, though a few may attain the length of several feet. Of the development of the Nematelminthes from the egg, not very much is certainly known in regard to most of the species. The parasitic members of the group are included in two orders, viz.: *Acanthocephala* and *Nematoda*. 1. *Acanthocephala*. This is a group of not very great importance to man, although it includes several not uncommon parasites. The name, which signifies thorn-headed, or spiny-headed, is given these worms because the head termimates in a sort of proboscis, which bears rows of small, sharp hooks, or spines. There is no mouth, nor digestive canal. The form of these worms is much like that of the common earth worm. The only representative of this group which it is necessary to mention here is one which is a very common parasite of the pig. This is knows as

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Fig. 19.
ECHINORHYNCHUS GIGAS. Natural size.

ECHINORHYNCHUS GIGAS, Goeze.—It is one of the largest of the Nematelminthes, the females being from five to twenty inches in length, while the males are less than half as long. Figure 19 shows the general form of this worm. It locates itself in the intestine of the pig, usually the smaller, where it fastens itself by means of the spiny proboscis mentioned above, this being pushed into the lining membrane of the intestine. Or, they may bore through this and migrate to other portions of the body, where their presence causes great disturbance. The eggs of this worm pass from the body of the pig and are eaten by the grubs of certain large beetles; in Europe by the grub of the cockchafer, a beetle allied to our May bug. In the stomachs of these grubs the eggs develop into embryos, or rather, the embryos already developed are set free and bore through the intestine and locate themselves in the body of the grub. Here they become encysted (i. e. encased by a thin shell of lime) and r main dormant until the grub chances to be devoured by a pig, in which case the development into a complete worm at once takes place. Sometimes the embryos of this parasite are found in land snails. As to its effects Prof. Verrill says: "In severe cases, hogs afflicted with this parasite are weak in the loins, and have the membranes in the corners of eyes swollen, watery and lighter colored than usual. The excrement is hardened and highly colored, and the animal often keeps up a continual squealing and grunting, especially in the morning. Such a hog is generally cross and morose, biting and snarling at its companions, but is usually too weak to defend himself if attacked in return and is easily thrown down. Finally the weakness increases until the poor creature is unable to walk about, or to stand. This parasite will probably yield to the same remedies used for tapeworms or those employed against the common round worms of man."

(2) NEMATODA.—This group embraces a large number of slender, thread-like worms, some of which are found in great numbers parasitic in man and other animals, the most noted and dangerous being the Trichina. The common pin-worm is a good example of a nematode worm. This parasite, *Oxyuris Vermicularis*, Brem, is shown in figures 20 and 21. The males, figure 20, are about one-eighth

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Fig. 20.
OXYURIS VERMICULARIS. Male.
a, natural size. *b*, enlarged.

Fig. 21.
OXYURIS VERMICULARIS. Female.
a, natural size. *b*, enlarged.

inch long and the females, figure 21, one-half inch, or less. It is a very prolific worm; but just how, or where, the eggs develop is not known. It is found more especially in children, but is not confined to them, as it has been found in persons of all ages. It is, perhaps, more frequently met with than any other parasite. It confines itself to the lower portion of the intestine, from which place it sometimes migrates and makes its way into a similar location in another person. When highly magnified the body of this worm is found to be regularly ringed. One end is rounded and the other tapering. At the rounded end is the mouth from which runs the intestine. In the female the posterior end tapers into a long filament like a tail. The mouth has three fleshy lobes or lips. The eggs are very small and of oval shape. These eggs develop into tadpole-like embryos, but just how or where they develop is not known. As to the effects of these worms little need be said here. If they occur in small numbers they do not seem to produce much disturbance, but if there are a great many they cause various more or less serious disorders and painful, or at least troublesome, sensations. As for remedies, any competent physician can recommend many, but that which, on the whole, seems to have proved most efficient, is the simplest and consists merely in using "oft repeated enemata." These may be given with either cold or luke-warm water, and by some it is thought that the addition of salt or "a few drops of anise oil," or "asafœtida," or "infusions of quassia or wormwood" is an advantage. Whatever remedy is employed, it must be repeated once in every three or four days for several weeks, to be thoroughly effectual. Another species of Oxyuris, very much larger than the preceding, is found in the horse, but it does not appear to cause any special disturbance. Another common human parasite is

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ASCARIS LUMBRICOIDES, Linn.—This is a round, smooth worm of quite large size, the male being about six inches long, while the female may be twice as long, figure 22.

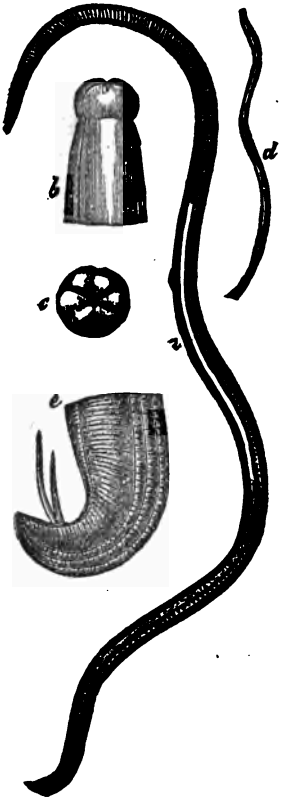

Fig. 22.—ASCARIS LUMBRICOIDES. *a*, female; *d*, male both matured size; *b*, head of female, side view; *c*, same, front view; *e*, posterior end of body.—From Packard's Zoology.

It occupies the intestine and, while if there be only a few of the worms present, and the host is in robust health, no serious consequences may take place, the case is very different if the number of worms is large or the person infested in feeble health. Several hundred have been removed at one time from the intestine of a child. In such cases they may cause convulsions and, usually, colic pains, nausea, nervous twitchings, restlessness and other disturbances. In rare cases they work through the walls of the intestine and reach various organs, when death may ensue. For treatment those in need of it should seek a trustworthy physician who will, in most cases, succeed in removing the source of the trouble, a substance called *Santonine* being regarded as specific. As a means of prevention we may again mention the necessity of using pure water for drinking, as it is probable that the eggs of this, as well as of so many other parasites, are taken into the body in this way. Another and smaller species of *Ascaris*, common in the cat, is sometimes found in man. Its habits, effects and treatment are essentially the same as in the preceding case. Other species are found in the horse and pig.

TRICHOCEPHALUS DISPAR, Rud.—This is found in the intestine of man. It is a small worm very much larger at one end than at the other which is drawn out to form a long, slender filament. The female is two inches long and the male one inch and a half. It probably is taken into the body with drinking water and in some places is very common, but its presence does not seem to cause any serious results.

Few, if any, of the Entozoa have aroused so much attention or been the subject of more careful investigation than the

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TRICHINA SPIRALIS, Owen.—So much has been published respecting this parasite that fullness of detail is not necessary in treating it here. Still, for the sake of completeness in this article, if for no other reason, I think that I may be allowed to speak briefly concerning it. The male Trichina is only one-eighteenth inch long and the female one-eighth inch. It has been found in many different animals, mature in the intestine and immature—encysted—in the muscles, such a muscle looking much like that "measly" with tape-worm cysts, but the Trichina cysts are much less easily seen. If a bit of such muscle be eaten by any animal in which it can develop, the embryos are set free from the cysts and pass into the intestine where they attach themselves and grow rapidly until they become sexually mature. They then pair and the males die at once, the females living until they have produced several hundred living young. These young Trichinæ speedily make their way through the intestine into various parts of the body and, carried by the blood to the heart, are sent first to the lungs and from there over the whole system, or, they may sometimes make their way directly to the muscles. According to some authors they are found most abundantly in those muscles that are nearest the abdominal cavity. Some of the worms remain in the heart, lungs, or other organs, and cause great irritation there. When they first reach the muscles they are small, thread-like worms, perhaps one-twenty-fifth inch long, and are free, but in a few weeks they become enclosed in oval cysts, which in time are hardened by a deposit of carbonate of lime, and they may now be so large as to be seen by the unaided eye if careful examination is made. When once protected by the cyst the Trichinæ may live in a dormant state for a long time even after the death of the animal in whose muscles they have been living. Indeed, unless swallowed by some such animal, they develop no further. The cases or cysts are about one-eightieth inch long and one hundred and thirtieth inch wide, though varying somewhat in size. They are not always oval, but may be spherical, or lemon-shaped.

Several years ago something of a panic was caused by the occurrence of several cases of the disease caused by Trichinæ in various parts of this country. While very much greater fears were in some cases aroused than was necessary, as the dangers were magnified and extravagant statements were made regarding the frequency of cases and fatality of the disease, it yet remains true that the disease is a very serious one and to be much dreaded and its cause avoided. It is not, nor has it ever been a prevalent disease, unless we except certain small districts, nor is it always fatal. It is easily prevented

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either by the disuse of pork altogether, (fresh pork, for I do not know that this or any other parasite is obtained by eating salted meat) or by taking care that such pork as is eaten is *thoroughly* cooked. In those cases where a whole ham is boiled this is not easily done for the inside may remain so little affected by cooking that the Trichinæ cysts are not destroyed. In parts of Germany and elsewhere prevalence of trichiniasis has been time and again directly traced to eating raw pork, either by itself or in Bologna sausage. This latter article has proved a prolific source of parasites. It seems to be impossible to detect the presence of Trichinæ in pork except by microscopic examination. The swine before being slaughtered may be greatly infested and still appear healthy, for, after the worm has become fully encysted, it does not usually cause any further trouble to its host, the previous inflammation having by this time disappeared. Hence absolute safety is to be gained only by absolute abstinence from pork unless it has been exposed for some time to a high temperature, or, in other words, *thoroughly* cooked. It seems pretty certain that swine become infected with Trichinæ from rats. Examinations of fresh pork offered for sale in market, has shown that Trichinæ in greater or less numbers are not very uncommonly present and this fact should be sufficient to induce those who eat fresh pork to be on their guard, for the disease is not a myth, but to those attacked by it a most terrible and painful reality, and yet it is so easily prevented by the precautions indicated that none need fear its assault. Prof. Gamgee, eminent both in England and this country as an expert in diseases of cattle, writes the following eminently practical and valuable suggestions: "It is interesting to observe that parasitic maladies in the pig specially abound in that section of the United Kingdom where swine live most among human beings. The Yorkshire and Berkshire pigs, in their native counties, inclosed in the farmyards of their breeders, are free from worms which are likely to live in the body of man. The Irish pig is the one most commonly injured by Entozoa, and the reason for this is evident when we know how much the cottager relies on rearing a porker, which is permitted the free range of house and yard where every description of filth is devoured, charged with ova of parasites expelled by man or some of the lower animals. * * We disregard in our ignorance the most common precautions to protect ourselves from loathsome diseases, and not only permit dogs to eat any kind of offal in and around slaughter houses, but sanction the existence of piggeries where all kinds of garbage, charged with

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worms or their eggs, are daily devoured by swine. The majority of germs calculated to engender parasites are to be found in abundance in the contents of the alimentary canal of human beings and domestic quadrupeds. If pigs are permitted to eat these we must expect hams, bacon, and pork sausages to be charged with the embryonic forms of human Entozoa." Another somewhat similar group of Nematode worms are the Strongyli. These are chiefly found in the air passages of animals, where by their accumulation they may cause suffocation; some are however found in the intestines.

Fig. 23.
MALE STRONGYLUS FILARIA.

STRONGYLUS FILARIA, Rud.—This is a slender, white worm, figure 23, the males of which are two and one-half inches long and the females three and one-half inches. It is found in the lungs and bronchial tubes of sheep and, less commonly, of cattle. If they occur in the lungs they make cavities which become inflamed and greatly damage the health of the animal, if they do not destroy it. In England this is a very serious pest, but thus far in America it has not been so frequent or destructive. If one sheep of a flock becomes infected the trouble is very certain to spread to others, unless prompt and efficient measures are taken to prevent it from doing so. The infested animal is continually sneezing and coughing the eggs more or less fully developed from its air-passages, or swallowing them and passing them through the intestines. The worms are not easily destroyed; it is even stated that they may be dried and in this condition kept for some time when, upon being moistened, they revive. Hence especial care should be taken to burn all that may be found. Naturally the complete isolation of infected sheep would be suggested to any one who understood the habits of this parasite. The eggs probably do not mature in the air-tubes of the animal, but pass into water, or damp places, where they complete their development. Hence, if the parasite should make its appearance in a flock, the uninfested animals should be kept from any stagnant water to which the flock may have previously had access. An allied species is

STRONGYLUS MICRURUS, Mehlis.—This infests young cattle and horses rather than sheep. It resembles Strongylus filaria, but the pouch,

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which is found in all the male Strongyli at the posterior end, has ten rays or bands in Strongylus filaria and five in Strongylus micrurus. The males are one and one-half inches long and the females three inches. It reproduces rapidly and is able to do much mischief. The head of this species is not enlarged, but furnished with three papillæ. If the embryo of the Strongylus passes into the stomach of a calf it makes its way through its walls into the circulation and thus reaches the lungs, where it becomes encysted and may remain for some time in this condition. On account of the presence of these cysts the surface of the lungs becomes red and nodular. These nodules are of various sizes, from that of the head of a pin to that of a grain of wheat; or, in some places, they may collect so as to form a hard mass of considerable extent. The covering in some is hard and calcareous, in others it is soft; the former being the oldest these are of a darker color than the younger and are less regularly spherical. At length the worms may become mature and make their way from the cysts to the bronchial tubes, and in this condition they are most injurious to the infested animals. They may exist in any portion of these tubes; sometimes singly, or in great numbers knotted and rolled together in balls, which may wholly close the air-passages in which they are found. Thousands may live in the lungs of an animal and each worm produce thousands of eggs, so that a rapid increase is amply provided for. The reproduction of Strongylus is thus described by one of the most thorough investigators of the subject:

"It is not necessary that the female should remain alive in order to the laying of the eggs; even when she dies the exclusion of her progeny is assured. If she lays them in the bronchia, the young ones are developed or expelled. If her progeny must be preserved for a more propitious season, or for another age of the animal which harbors them, she incloses herself in a tubercle in one of the air-sacs, afterwards dies and is transformed into a veritable bag of eggs, destined to furnish, insensibly and for a long period, the contingent which the living worm would have been able, in other circumstances, to render at one laying. In the cyst they hatch successively with a certain slowness, remain small, unsexual, and live surrounded by the debris of their mother. Later they develop in the bronchia, become sexual, adult, copulate, and prepare, it may be, for a new (internal) reproduction in the lungs. Out of the body of their host, in water, after the death of the mother, its body swells, its skin is torn off, and the oviducts float free, and masses of eggs and myriads of embryos escaping disperse themselves at the bottom of the water.

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There are here two facts—the birth of the worms in the dead body of their mother, and the external life of the little ones, the cause and condition of the contagion. In effect, the animals, of which the bronchia conceal the Strongyli, reject them under the influence of cough and the expectoration of mucus charged with worms, which fall on the food, the litter, upon the soil, or in the water drank; the mothers die, but the eggs are hatched, and the living brood wait till they have the opportunity of entering the bodies of the animals. It is above all in water that they are long preserved outside the animal economy. * * * * Water is a transition medium in which the worm which has abandoned one animal can survive, waiting for a favorable opportunity to enter another. In this medium the Strongyli are hatched and live for entire weeks and months without perceptible growth." From these facts it is obvious that Strongyli will be most likely to occur in animals feeding on low, wet ground and in wet seasons. It has also been noticed that young animals pastured upon land that had been recently occupied by older cattle were more liable than others to be infested.

The appearance of a calf infested with this parasite is much that of one with bronchitis, but its presence can certainly be determined by an examination of the mucus coughed up, as this will disclose the young worms, looking very much like bits of white thread. The skin of the animal becomes dry and the body thin. Later in the disease the animal is very weak, with sunken eyes, rough coat, (though this may appear at first), the cough becomes violent and sometimes the animal is suffocated during a fit of coughing. It has little or no appetite and at last dies. The time which a calf can live after being attacked varies greatly with cercumstances—it may be less than two weeks, or it may be several months.

As a means of prevention of this parasite Prof. Law suggests the following: "Two indications present themselves as calculated to prevent this disease: 1st, to prevent the worms from gaining access to the system. 2d, to bring the animal into a condition unfavorable to the development and destructive work of the worms.

1st. In localities where the parasite is known to exist, lambs or calves should not be pastured on land recently occupied by sheep or by older cattle or horses. Lambs may be safely grazed after horses or cattle, or foals and calves after sheep, but no young animal in such a place should be allowed to graze after any creature liable to harbor the specific parasite, to whose attack its lungs are obnoxious. 2d. Overstocking should be avoided. If the parasite is introduced

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on any pasture the facilities for its increase will be in exact proportion to the number of animals present in whose lungs it can attain full sexual development and reproduce its kind. 3d. Thorough drainage will go far to prevent it. As the young worms must live in water or in moist earth, the facilities for their preservation will be increased according to the springs or marshy nature of the soil. 4th. Young stock must not be allowed access to water coming from a field containing beasts infested with its own pulmonary parasite. 5th. Pastures or water in which any particular pulmonary parasite has gained a footing should be denied to all animals known to harbor that particular parasite, or, still better, the soil may be torn up with the plow and subjected to a rotation of other crops until time has been allowed for the destruction of the germs. 6th. No affected or suspected animal should be placed with others. * * * * 7th. Feeding young animals on grass wet with dew, or on clover or other such fodder as affords by its abundant moisture a suitable nidus for the young worms, is to be avoided. 8th. Carcasses of those dying of the affection should be deeply buried." For remedies various substances and methods have been recommended. Prof. Law advises feeding a liberal diet of "oil-cake, rape-cake, roots, corn, oats, beans, or other sound, nutritious diet, to which may be added a mixture in equal parts, of powdered sulphate of iron, gentian and ginger, in the proportion of four ounces of the mixture to every ten calves, daily; lambs may take two ounces to the same number, daily, at three months old." Those worms which are in the throat or bronchial tubes may be readily destroyed by shutting the animal in a small room and burning flowers of sulphur until the air is filled with the fumes as completely as the animal can bear without paroxysms of coughing. The owner may remain in the room with the animal and thus be constantly aware of its condition. The calf should breathe this for half an hour, and in a few days the process should be repeated, perhaps as soon as the next day, and again after three or four days and if needful, again in five or six days from the last application. Carbolic acid fumes would perhaps be quite as good. These can be produced by placing a strong solution of the acid in a deep dish and dropping red hot bits of iron or stone into it and causing the animal to breathe the vapor thus produced. The chief trouble is to reach the encysted worms in the lungs. There have been several out-breaks of this trouble in this country and may be others at any time.*

*While the above account was going through the press Mr. O. M. Tinkham sent me a lung taken from a calf killed in Fairlee which contained many thousands of this parasite.

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STRONGYLUS ELOGNATUS, Dry.—This worm, which is not uncommon in the lungs and air passages of swine, is similar in its character and habits to the species just considered. It is smaller than the preceding, as the females are only one and one-half inches long and the males about half as long. In a recent report on "Diseases of Swine," Prof. Law says that, "Like all parasites, they multiply rapidly wherever their propagation is favored by the presence of large herds of swine, and especially if these are kept on the same range and water season after season. In such circumstances they will produce a veritable plague, proving especially destructive to the young pigs. There is little doubt that many outbreaks of alleged hog-cholera, in which the lungs alone are affected, are but instances of the ravages of these lung worms, but that they are the cause of the specific fever which we are investigating is negatived by the complete absence of these worms in all of my second experimental lot." These worms are white or brownish in color and the pouch of the male is bilobed, each lobe bearing five rays. Several species of Strongylus inhabit the intestine of various domestic animals. A parasite which in some regions has caused great trouble is the kidney or lard worm,

STEPHANURUS DENTALUS, Diesing.—It is reported from various portions of the country. It is, in the female, from one and one-half to one and three-fourths inches long and in the male one and one-fourth to one and two-fifths inches long. It appears to be quite common, occurring most commonly in the fatty portions of the animal, especially in the kidney, but it has also been found in other organs. It occupies irregular cavities which contain, besides the worm, dark colored pus-like matter, in which ova may also be found. There may be several worms in one cavity. The mouth is "oval rather than round and is surrounded by a hexagonal frame, each corner having a papilla and hooklet, while each side is armed with six serrate teeth." "The caudal extremity of the female is spindle-shaped, but has two bursæ higher up. In the male it is formed by three-lobed bursæ, above which are two well developed spicula." Prof. Verrill says in regard to this: "Although this parasite probably does not exist in the human body in any stage of its growth, there can be no doubt but that the pork and lard from hogs infested by them must be unwholesome. That such diseased pork is constantly sold in our markets is certain." It has been supposed that this worm causes hog

All the air passages were filled with them so that it is difficult to understand how the animal was able to breathe at all. In this case death would have undoubtedly speedily taken place.

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cholera, but this belief is not warranted by thorough investigation of this disease. Another parasite which is also by many supposed to be the cause of the above named disease, though it seems certain that it is not, is known as

SCLEROSTOMUM DENTATUM, Diesing.—This is a small worm living in the intestines of hogs. The males are about one-third inch long, the females one-half inch. The body is of a dark color and the surface is finely marked over with transverse striæ. It is quite slender and tapering at each end, but the male has, near the tail, a three-lobed expansion. The eggs are laid in the intestines from which they pass into the open air and soon hatch. The mouth of this worm is circular and armed with six teeth by means of which it attaches itself to the intestine and pierces the tissues feeding upon the blood. If there are many of them they create such a drain upon their host as to weaken and possibly destroy it. It may also by its irritation of the bowels cause serious trouble and disease. There is another species of this genus,

SCLEROSTOMUM EQUINUM, Dry., which occupies the intestines of the horse, ass and mule. It is a reddish worm, one and one-fourth inches long in the male and one and one-half to two inches in the female. The mouth is surrounded by rows of fine hooks by means of which it attaches itself to those parts which it infests. It is said sometimes to exist in such numbers as to almost wholly cover the large intestine, and, of course, in such a case considerable injury must be done, but it seems much more injurious when lodged in an artery, for here it produces large dilatations. No remedy has been discovered for this parasite. There is a large worm, Eustrongylus gigas, Dies., found in the kidneys of most of our common animals and of man. The female is sometimes three feet long, though not generally so large, while the male may be one foot long. It is a smooth, reddish worm. When it is located in the kidneys it gradually destroys the organ.

SYNGAMUS TRACHEALIS, Siebold,—the gape-worm of fowls—is well known, the presence of which in the windpipe of fowls, and, as well, of many wild birds, causes the disease known as the "gapes." This worm, figure 24, is of a reddish color. The females are three-fourths of an inch long, while the males are only one-eighth of an

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Fig. 24.
SYNGAMUS TRACHEALIS, gape-worm – *a*, natural size; *b*, female, *c*, male, both enlarged. From Cobbold.

inch long. They are almost always found paired, as the male usually grows to the female. In both the anterior end flares like a funnel and the mouth is in the middle of this depression. The mode of development of the worms outside of the windpipe is not known. Of course, as the difficulty is caused by the presence of the worms in the windpipe, where by stopping it up they may cause suffocation, the most obvious remedy is the removal of the worms from the windpipe, and in many cases the bird dies from the effects of its presence unless such removal can be effected. The old remedy of wiping the worms out of the windpipe by the use of an oiled feather often proves quite effectual, but it often does not. Perhaps a mixture of carbolic acid and glycerine would be better than oil, with which to moisten the feather, though there would need to be not very much of the acid. A correspondent of the New York *Tribune* recently suggested the use of tobacco smoke and says that it has proved very successful in his hands. In using this remedy care must, of course, be taken that the remedy does not prove as fatal as the disease. Dr. Cobbold gives an instance in which the windpipe was opened by a slit about a quarter of an inch long and the worms taken out. The wound was then sewed up and perfect recovery ensued. Such a remedy would not be likely to prove successful in ordinary hands, but in extreme cases it might be attempted. As the gape-worm is very tenacious of life, all that are obtained should be burned. All poultry harboring the parasite should be at once and completely isolated from the rest. Sometimes change of food, with infusions of garlic for a drink, have effected a cure. Turpentine applied externally to the throat is said to effect a cure.

One other nematode worm is so common and so well known that I wish to speak of it in closing. This is the common hair worm often seen in watering troughs or pools swimming over the surface. There are several species belonging to two genera, Mermis and Gordius. As it is even now supposed by many that these worms are really derived from horse hairs, a few words concerning their history will be of service. The history of the most common hair-worm, Gordius aquaticus, is as follows: The eggs, which are produced in immense numbers, are laid in the water, where the embryo undergoes great changes. At first it lives as a parasite in cysts in the

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larvæ of certain flies. These flies being eaten by fish the Gordius in the next stage lives in the intestines of the fish, where it becomes encysted. In course of several months it bores through its cyst, goes into the intestinal cavity of the fish and thus passes out into the water. Here it changes its form, increases in size and finally makes its way into the body of a beetle, grasshopper, or other insect, where it lives for some time, sometimes nearly filling the abdominal cavity. Other species live in the adult state in moist ground, often leaving the bodies of their hosts. It is asserted that many of the Rocky Mountain locusts are destroyed by these hair worms, and, on the whole, these parasites are to be regarded as beneficial.

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THE SOIL, ITS FORMATION AND RELATION TO THE ROCKS.

By His Honor. E. P. COLTON of Irasburgh.

This subject is one which does not require more study and observation than many others which may be discussed at meetings called by the superintendent of agricultural affairs. It is not a subject specially in the line of the geological student, or practical chemist, but one which should engage at least a portion of the leisure of the agriculturist. It is a book always open, profusely illustrated, showing the records of past epochs, in the study of which the mind never wearies, ever disclosing wonderful facts uniting the past with the present.

What I do say in this paper will be of a local character, because there are so many varieties of soil in different sections of this state, that to take them up in their regular order would require more time than is allotted for that purpose at this meeting. The primary cause which resulted in the formation of soils was, first, the upheaval of the rocks from the original position in which they were formed, the grinding process of attrition and abrasion, decomposition or disintegration, and the accumulation of vegetable loam caused by the decay and decomposition of the growth of plants upon the surface.

The stratified rocks of Vermont were deposited according to the laws of nature, and formed under water with the strata and rifts in a horizontal position, and by some great convulsion or cataclysm these strata were upheaved and uplifted and left at every conceivable angle, and in every position, so that the elements could play their part in the great laboratory of nature in reducing these hard substances to soils, thus fitting the earth for the habitation of man.

The rocks thus alluded to are the various slates, shales, lime and sand stones of the state. Besides these, we have what are termed igneous or metamorphic rocks, which are harder than those named, and are found in dikes, which were fissures and rents made through the stratified rocks after their displacement and upheaval.

The material with which these dikes were filled was the result of subterranean heat upon the various rocks which had been formed, reducing them to a liquid or plastic state, in which condition they

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were forced into the cracks and fissures through the various strata to the surface, and in many instances large areas of broken and uplifted strata were overflowed by this hot and plastic material. These igneous masses cooled in the position they were left by the flow, the heat often being so intense as to entirely change the character of the rocks to which the mass adhered.

Among the igneous, or trap-rocks, are classed the granites, porphyries, basalts, greenstone, and others which are named in any treatise on mineralogy. The evidence of the rocks show that the upheavals and the formation of trap-dikes occurred while the surface was covered with water, which, with the convulsions of nature, the filling the rents with molten liquid, the boiling and seething of the waters, the emitting of steam and the generating of gases, was another act in the great chemical laboratory of nature to disintegrate and reduce these substances to powder.

After this epoch there was a subsidence of the waters, the rocks were subjected to the influences of heat and cold brought about by the change of seasons, the work of disintegration commenced, the rough angles of the softer rocks lost their sharp outlines by the action of winds, rain and frost, rocks became decomposed at the surface, and vegetation sprang into life; plants bearing seeds having light, silky plumes, or wings, float and flutter in the air and are carried afar by the winds, while others having seeded envelopes are floated by the waters without injury to their powers of germination. Thus vegetation sprang up over the surface of the rocks, and while it was drawing a scant subsistence from the shallow soil, animal life was introduced, and this was the reptilian age of the world—an age in which huge monsters now extinct sported in the rivers and ponds and cropped their subsistence from the vegetation of the valleys. Evidence of vegetable and animal life during this age are seen in the lignite beds at Brandon, and in the fossil trunks of trees often found under deposits of drift, in the remains of the bos primevus, and in the fossils of the eocene cunudensis.

Another, and perhaps the most powerful agency in the process of soil making, was what has been justly termed the "Drift." Men disagree in relation to the means by which the deposits were made, some claiming that floating icebergs were the carriers, while others contend that it was the result of moving glaciers. The glacier theory has been generally adopted by men who have investigated the subject, and in a section of country like ours there are abundant proofs of glacier action.

In order to properly comprehend the glacier theory, it is necessary

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that we understand that the temperature of the atmosphere sunk so low that the whole country was covered with ice; that by continual freezing and the accumulation of snow, the valleys were all filled and the tops of all our mountains covered, and that this immense mass, two or three thousand feet thick, moved over the country, crushing and grinding the rocks, scraping off the tops of the hills and mountains, filling the gorges and valleys, transporting rocks and soil from one section to another.

Over the northern and north-eastern parts of the state the glacier moved from nearly north-west to south-east, and was the agency which broke off the sharp angles and gave our hills their beautiful and rounded surfaces, which pulverized and mixed the various minerals so essential as plant food; it was, in fact, the great leveler which did more towards fitting these hills and valleys for the habitation of man than any one agency brought into use for that purpose. The course of the glaciers, except in the northern parts of the state, was usually down the great valleys. The marks of their courses show that the great glacier which swept over Orleans county was broken into smaller portions which followed the course of the valleys, though in some localities evidence appears that glaciers have crossed and others have followed down the course of the valleys—the existence of moraines fully proves this fact.

The mountains of Vermont remain the same as at the close of the glacial epoch, except the wear and tear of the elements upon their surfaces; but there has been a great subsidence of a large portion of Canada since that age. The course of the great glacier fully proves that from the Adirondack mountains in New York, thence northwest, was once very high lands, and from that source came the ice, or from those highlands originated the glacier. The azoic rocks of northern New York, and the continuation of them in a north-westerly direction to the Arctic ocean, shows that there was the neuclus from which the continent grew. Those isolated mountains of Canada are portions of the great chain, and were islands in the great inland sea which overspread that portion of the country after the subsidence; their abrupt and precipitous sides show the action of the waters of this sea upon them. In order to properly understand our soils it is necessary that we have a knowledge of all rocks which lay in place in the direction from which the drift came. In considering our soils, we have, first, what are termed interval lands, which are sometimes composed entirely of alluvial deposits which have been brought down by the streams. These deposits may not hold but a small quantity of the fertilizing qualities contained in the rocks

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which out-crop in their vicinity, and are usually more finely pulverized and contain a greater per cent of vegetable humus than is found in uplands. The fineness of a soil enables the mineral salts contained therein to be taken up by roots of plants, which makes interval, or bottom lands more valuable for the growth of certain cereals than uplands.

Next in order we have the terrace formations, which were deposited when the valleys were a succession of ponds and lakes, the materials having been brought by the waters from the hill-sides and deposited in what was the shallow waters or shores of such ponds and lakes. These terrace formations are composed of a conglomeration of sands and gravel, and were the result of the last washing and settling process after the drift period, and previous to the present finished topography of our valleys. They are free from bowlders and stones, but in some deposits immense beds of gravel are found which contain pebbles from every rock to be found in place along the valleys, and from every out-crop to be found for miles along the course over which came the glacier. The best course of cultivation for these terrace lands is to so work the soil as to release the mineral properties therein contained, so that it may become available as plant food. Next above the terrace formations, (in some localities where the valleys are broad) we find large areas of sand and gravel hills, undulating tracts, clay beds and clay soils, all of which have no distinct relation to the rocks that underlie them. It is on these lands that the agriculturist needs science to aid him in his efforts to wring a subsistence from the earth. These sand and gravel hills and clay deposits were the result of the first thawing and settling process, after the great glacier ceased to move over the country. When the temperature had raised sufficiently to thaw the great mass of ice, the valleys were filled in many places to the tops of the surrounding hills by drift material brought along by the glacier, which caused a succession of lakes and ponds in our valleys; but, earlier still, came the subsidence of the valley of the St. Lawrence, and in Orleans county where these sand and gravel deposits are found, it was then the shallow water of the great inland sea, which covered nearly the whole of the Province of Quebec, and a large proportion of the county of Orleans. Our mountains and highest hills were islands in this great inland sea, and great tidal waves from the north drove the waters with a mighty current through the gorges between the mountains, among which may be named those at Island Pond, Willoughby lake, South Barton and Elligo pond. The sands and gravel to be seen in the towns of Burke, Lyndon and St. Johns-

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bury were washed from the hills in the towns of Brownington and Westmore, and deposited on the other side of the divide. The undulating surface of these deposits show plainly that they were deposited under water, but the existence of this inland sea was only of sufficient duration to deposit the Quebec group of rocks in the valley of the St. Lawrence. The subsidence of that part of the continent where now lies the valley of the St. Lawrence, the filling the depression with the waters of the ocean, was one of the providences in nature which aided in thawing out a frozen continent.

The next act in the drama was the elevation of the eastern part of the continent; which elevation found our valleys choked by drift, our ponds and lakes were freezing and thawing, and it was at this time that our clay beds were deposited; where we find pure clay we know that it was deposited in still water, which could only have been done when it was covered with ice; and when we find clay and sand in alternate layers, we conclude that it was a day and night work, the clay having been deposited when the water was covered with ice, which ice, having been thawed by the heat of the sun during the day, the winds moved the waters and the layer of sand was deposited, to be succeeded by a layer of clay at night, and so the deposits were made till the waters became clear.

Among these sand and gravel formations we frequently find tracts or plats which have clay combined with fine sand, and which prove to be of great value for the growth of cereals. These last named deposits are less liable to be affected by drouth than any of this class of deposits. They were deposited while the waters were gently moved by some cause which prevented the particles of clay from adhering together

All these soils are called drift, and they are so, but they have been distributed by water since their original deposit by the glacier. They all have the elements of plant food, and all that is necessary to secure good crops when seasons are favorable, is to so till them that the mineral plant food may become available. In these soils may be found fragments of all rocks existing north and north-west of the deposits. Their condition does not depend upon the rocks which underlie, or out-crop along the hills above them. They are a grist from the mills of the gods, which have been ground, bolted, and washed to their present condition.

The chemical means adopted by nature for the disintegration of the rocks is not idle here. Those minerals which contain metallic sulphates become, by the gradual absorption of oxygen, converted into sulphates, which are not only soluble in water, but absorb

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moisture from the air and thus crumble down. In the disintegration of silicious minerals, the process is equally simple. Silica, a very pure variety which occurs in quartz, is insoluble both in hot and cold water; it unites with alkali and forms saline compounds termed silicates; the silicates of potash, soda and lime are neutral compounds; and, as this property of neutralizing metallic oxides and alkalies belong only to the acids, silica has obtained the name of silicic acid. This acid is exceedingly feeble—so much so that it can be decomposed by carbonic acid.

Feldspar, one of the ingredients of granite, may be regarded as a silicate of alumina with a silicate of potash. All minerals and rocks containing silicates of alkaline bases cannot resist the continued solvent action of carbonic acid dissolved in water, and in this way, either in the form of soluble silicates or a hydrate of silica, this important ingredient in some plants is taken up by the roots. All plants of the grass kind require silicate of potash, the amount of which removed from a meadow in the form of hay is considerable, as any one can see who examines the melted ashes of a pile of hay which has been burned. Next in the order, as we ascend from the valleys, we find large areas of smooth surface gently rising to the tops, or nearly so, of our hills and mountains. These areas are confined exclusively to the north, north-west and westerly sides of our hill and mountain ranges. They are always to be found where the great glacier passed, and are deposits left in its course which have not been disturbed by water since the epoch of ice.

The glacier in its course rose over the hills and mountains, breaking and scraping off all the sharp angles, depositing and packing the debris on those sides of the barriers named, until they formed an inclined plane from the summits to the valleys below. These inclined planes have been furrowed by brooks and rills which have run from the summits to the valleys; in many places deep ravines are seen, but the material of the deposits never varies—they are always the same, and are historical leaves in the great book of nature, which may be read as easily as can the terraces along our river banks.

These inclined plane deposits are commonly called "hard-pan;" they are the drift primeval. These soils have sufficient clay to give them a bluish color, in which may be found fragments of nearly all rocks to be found to the north-west. They remain as they were left by the great glacier, packed so close that to remove them parties often resort to the drill and blast. All the mineral salts contained in the rocks of these deposits has lain dormant. They are so com-

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pact that air or water cannot permeate them, and specimens as fresh as if just taken from the quarry may be washed from any of these beds. Here, in juxtaposition, may be found the green and yellow serpentine from Missisquoi ? valley, the talcose slate and granular quartz from Jay Peak, epidote and limestone from Berkshire and Richford, variegated sandstone from the Swanton deposit, black quartz from Rougemont in Canada, red jasper from the Laurentide hills north of the St. Lawrence, and we might enumerate all the known minerals from those sections, and we should then have rocks in this "drift primeval" which have not been noticed or discovered by the mineralogists who have surveyed the Canadas. The underlying rocks show the marks of the great glacier, and all the pebbles and bowlders of these deposits show the effects of the grinding process. It is well that these deposits have their surfaces like an inclined plane—were they level they would be useless for agricultural purposes; their surfaces would be covered by stagnant water. All these lands were covered with a vegetable loam, which produced good crops until exhausted. In most seasons these hardpan lands produce fair crops of grass, but they are affected by drouth as seriously as any soils we have. They should not be plowed when wet, and they cannot be tilled when dry. The best course is to plow late in summer, then pulverize the soil in the spring before it is thoroughly dry. This manner of treatment will be found to give greater crops than if tilled when wet. These lands are of more value for grass than grain. They are too hard to work over and till, after having been laid down smooth. Underdraining, to admit air, if for no other purpose, would be beneficial.

It is frequently the case that the water of wells dug in these deposits, and of springs which issue from them, have that peculiar nauseating smell and taste which waters have that are impregnated with sulphureted hydrogen. Many wells have this peculiarity years after their construction, and whether this is owing to the release of sulphur from the bi-sulphuret of iron which is annually decomposed by water, or from some other cause, I leave for those to determine who may give the subject their special attention.

Next in order we come to the tops of the hills, which we have approached from the west. It is on the top, and on the easterly, south-easterly and southerly sides of our hills and mountains that we find soils that owe their fertility to the underlying and outcroping rocks. This is particularly the case where the rocks are of the micaceous and calcareous clay slate formations. These soils are mainly the result of the disintergation of the rocks which underlie

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them; they are a light loam, porous and fertile, giving as great returns to the husbandman for his labor as any soils we have. Another advantage is that they are not seriously affected by drouth, and their altitude is usually such that crops are seldom injured by frost. All our longitudinal ranges of hills and mountains have their sloping sides on the west and north-west, and their abrupt and precipitous sides on the east and south-east. These hill ranges were too firm to be crushed.

By the great glacier their tops were torn off and rounded by its course; their westerly sides filled with drift, their east and south-east sides left nearly in their original positions, receiving only such portions of the drift as fell from the great mass of ice which was being forced along over their sides. Drift material which lodged in this way, was easily carried by the waters into the valleys below, leaving these hillsides to be made into soil by the work of disintergration and decomposition. It is upon these hillsides that the best grazing lands are found; here will be seen the greenest grass in early spring, and from these pastures come the fattest beeves and mutton. These soils have nearly all the elements of plant-food, and it is only by gross neglect and carelessness that they are allowed to become unremunerative. It is around these hills that are found the most valuable muck beds, the muck holding a large percentage of lime from the rocks which have decomposed. It is also in their vicinity that extensive beds of shell marl are found, which of themselves are sufficient fertilizers, of that material, for all coming time.

Probably no section of New England, and perhaps no part of the United States, has so great a variety of soils as northern Vermont; and here, if anywhere in the country, it is necessary that the agriculturist be educated up to the business of his calling. Practical farmers disagree as to the best methods to be adopted for the cultivation of certain soils. Some tell us that we must return to the soil as much plant-food as we take from it. If this were true nothing could be sold from the farm. Many agricultural writers conduct imaginary farms, and write books that prove that by-and-by the earth will have yielded to continual cropping all that there once was in it of ability to produce food for man, and that in the end starvation is to depopulate the earth.

What we should aim to do is to develop as much as possible the plant-food which lies latent in the soil, and not carry off in the form of crops any more than we annually develop from the soil. In this way the condition of the soil would remain the same. If we take off less than we develop the condition of the soil will improve. Now

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by stirring and cultivating the soil we release plant-food which lies dormant, and is dead capital until released and pulverized so that atmospheric influences operate upon it. If the stirring the soil develops one hundred pounds of plant-food a year, and only seventy-five pounds were carried off in crops, twenty-five pounds would remain in the soil to improve it, which might be in the form of roots and stubble; the land at the expiration of forty years would contain, provided none of it was lost, one thousand pounds more of available plant food per acre than the uncultivated strip. Very many of our soils contain to the depth of eight or ten inches enough nitrogenous matter in an acre to produce two or three thousand pounds of ammonia. By pulverization this may be released and would nourish growing plants, and if not all taken from the soil, the condition be improved. The doctrine that we must return to the soil in the form of manures as much as we take from it in crops is simply an impossibility.

The great cause of so many of our older farms being in so poor condition has been neglect on the part of their occupants. They have skimmed over the surface with the plow; have worked their soil in the most careful manner, until their lands have become demoralized. The time was when the rich fresh soils, backed by the grand old forests, yielded an abundant harvest by force of muscular effort on the part of the husbandman. To-day, vast areas of the surface soil have been harassed beyond endurance, and yield scarce enough to entitle the product to the name of a crop. Treading in the footsteps of their fathers, and farming in the time-honored way of their grandfathers before them, the surface soil has become almost exhausted of many essential elements of plant-food. The farmer of to-day, as well as the coming one, should be educated in agricultural science, and then reduce his knowledge to practice. It has so long been customary to associate mental activity with physical inactivity that we are apt to think that this must necessarily always be so.

In order to make farming a success, not only muscle, but brain and heart must each take part. Education in the line of some chosen pursuit is now in order. Happily farm work now requires a greater range of mechanical ability than formerly, and we have reason to believe that many other faculties which have heretofore seemed out of place on the farm, will soon be called into requisition in order to enable the farmer to achieve a full measure of success. Successful farming, as we understand it, implies not only pecuniary gain, but a constant increase in the acquisition and introduction into our system of farming of newer and better ideas than we formerly pos-

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sessed, coupled with an increased desire for a special knowledge of our pursuit, and a higher perception of our social relations to each other.

In this practical age practical results are of the first importance; therefore the farmer should be educated in the line of his profession. He should have a clear and a definite knowledge of the principles upon which his occupation is based. It is important to the farmer to know why the application of certain principles produce certain results. Every farmer ought to know the nature of the soil he is cultivating, in order that he may have a correct knowledge of the best methods of growing his crops economically. We do not expect that every farmer will become an analytical chemist, but we think all should have such a knowledge of geology and chemistry that they may be able to give at least the percentage of coarse and fine sand, the amount of clay and humus contained in the soil they propose to cultivate, and possess a general knowledge of the geology of the surrounding country. At all events, they should be able to make a fair estimate of its productive capabilities, and of the kind and quantity of fertilizers that is requisite in order to grow crops that will be remunerative. If soda or potash be added to a sandy soil, it forms a combination whereby the silica is dissolved and made available as plant-food. Surely every farmer ought to know that soda, potash and lime when combined with sulphuric acid are called sulphates; and when with muriatic acid are called muriates; when with nitric acid are called nitrates; when with carbonic acid are called carbonates; and that all are valuable to him, and that the first three will fix the ammonia in his manure heap, and the last will not.

It is not wise to suppose that special attention given to the judicious breeding of fast horses, the raising of coarse, fine or long wooled sheep, the developing of the best dairy cow, or experimenting upon the various methods of making butter and cheese is sufficient, while the basis and foundation of all these industries is neglected.

The practical and successful farmer must study and become acquainted with all of the branches of a variegated agriculture. There is no pursuit or calling which presents such a variety of opportunities for developing intellectual eminence. One-half hour each day devoted to reading, one-half hour devoted to field study and investigation will be sufficient to post up and educate any farmer who will put that much time to that purpose.

The hills and valleys of Vermont were not designed by the Creator to be skimmed over by taking off a few crops and then be allowed to run to unoccupied and barren wastes. The elements of eternal

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fertility are in our hills and dales; they are destined to produce food for millions, and if not developed by the race now occupying them, it will be only a question of time when we must step down and out to give place to those who by their intelligence and industry can create wealth where nature has so bountifully bestowed her favors.

Where the broad areas of the west have become unproductive by continual cropping, the farmers compelled to use commercial fertilizers to return plant-food to the soil, then will the hills and valleys of Vermont be known and recognized as the Eden of America. The longer our soils are cultivated the better they will become. They have in them the elements of fertility which only require the process of release from their dormant condition. Time, the frosts, the humid atmosphere from our mountains, and intelligent husbandry will aid us in unlocking these hidden treasure in our soil. The time has come when the farmers must apply brain-work with muscle, the creation of "Boards of Agriculture," the appointment of Superintendents of Agricultural Affairs, the establishing of Farmers' Clubs and Granges, the interest taken by the farmer in the welfare of all associations which aim to elevate his condition, show that we are taking steps in the proper direction.

The same rule applies to the farmer which applies to all other classes of the world's workers—they cannot be successful in their calling without close and intelligent application to their duties. By industry, study and economy, they may become the most independent, intelligent and wealthiest class of the people. They have the health, the brains, the land, which is the basis of all wealth, and the majority. It is their fault if they do not profit by their facilities.

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ON KEEPING OUR BOYS AT HOME.

By Mrs. J. M. WRIGHT, Enosburgh, Vt.

When I received a line from your secretary asking me to write an article for your farmer meeting, I felt like declining, as doing such things late years was out of my line of practice; writing family letters was about all I found time for; and as for writing on the subject of "keeping our boys at home," I told your committee that I had not much experience in that direction, having but one boy, although he loves his home and the farm. Some one who had brought up a family of boys and seen them all settled for life could have done it better. The answer of Ahab, king of Israel, to Benhadad, who was boasting what he would do, runs in my mind: "Tell him, let not him that girdeth on his harness boast himself as he that putteth it off."

But really, that subject is one of vital interest to us in Vermont, when so many of our young people are leaving the ancestral homes for the distant west—although it is not like leaving your native land, and you still are citizens of one great country. It is hard to have our children go out from us, and equally so for them to leave the home and friends of their youth.

Our boys have many of them got the idea that Vermont is not much of a place to get a living in; everything looks tame and uninteresting; visions of the great world fill their mind; they must go and see for themselves what the great west is. I do not wonder at it, your country is of such vast extent. It may be because Vermont is so much like my own dear native Scotland that I love it. And if, as a western man told me, her fields and valleys were dreadful narrow, they are pleasant to live in.

I think you Vermonters ought to be more proud of your native state, her glorious mountains, her dales and clear streams, and it ought to be your aim to keep your farms in your family for years and generations yet to come—not trying to scrimp and save to put money at interest and as soon as your farms are paid for sell out and live in the village, but use your money to improve your farm and buildings, making home more attractive and pleasant.

One great objection to living on a farm is its isolation, as it were. It is natural for us to seek companionship, recreation and enjoyment,

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and in such a meeting as this we feel that our aims and hopes are one. If we would keep our children with us we must make our calling lucrative as well as attractive. One trouble is that farmers pay such taxes on their lands when they do not own them. It seems to me that the holders of the mortgages ought to pay more of the taxes than they do.

One thing I notice, you farmers in New England do not boast about your country, your crops, etc., as they do at the west. They are all the time praising their land, their crops, their "go ahead," their smartness. See how the west are advertising their lands all the time! Just think what Kansas and Colorado did at the centennial! It was perfectly astonishing, the display they made of the products of these states! And what is the result? Our boys going there to make homes!

What did Vermont do? Almost nothing. The smallest house on the grounds, a few sheep, some marble, a fire-engine—hardly anything to show how she stood as an agricultural state—it was a shame!

One gentleman made the remark in our last meeting that one reason why the boys did not like farming was that all the offices of trust and emolument were in the hands of the other professions, and the farmers went with a rush after the lawyer and the merchant to put them in office. I trust that will not long be the case in this town.

All our boys cannot be farmers; it is not every one that knows enough, for I hold that it takes brains to farm successfully as well as any other business.

We must train up our boys to feel that useful, compensated labor affords the only means of independence, and of growth, physically, mentally and morally. No man is *respectable*, in the highest sense, who is an idler; the active only have the true relish of life, for they who know not what it is to *labor* know not what it is to *enjoy*. It is *exertion* that renders rest delightful and our sleep sweet and refreshing. But they want remuneration for their labor. If they think farming does not pay they will not choose that calling. Men seek wealth to enable them to get the comforts of life. We ought to teach our boys to buy and sell and farm as other boys learn a trade, to have something to call their own. I know one family of boys in the west who are as enthusiastic farmers as any I ever saw; each boy had some particular thing that he was interested in. The oldest son had invested in some fine swine, and showed me one fine one weighing over five hundred. The second

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one was interested in fruit and helped his father cultivate a large orchard, acres of small fruit; the third had charge of the horses and a pony of his own; and the other two had different kinds of poultry. Their father was a live farmer, one who led his boys instead of driving them. Some years ago, in talking with a young man who was born and lived to manhood in this town, he said: "Nothing would tempt me to be a farmer; too much drudgery about it; he never had a chance to dress up and go into the parlor when his folks had company; no, there was always chores to be done." There was a great mistake there; there ought to have been time for rest and reading. *I* think a well-to-do farmer the most independent of mortals. I have come across a piece by Mr. Barnard of Westminster, which I will copy:

"The theme before us is not new. It has claimed and will claim serious, earnest attention. What shall be done with our boys? What shall our boys do with themselves? Care for the boys at home, early; not simply for their physical wants, these to be sure—but for their habits of thinking and acting, for the influences that give impression as to the object of life. Teach them early that there is work to be done, that industry is an essential to success and happiness, and that idleness will clothe a man in rags. Let it be understood that it is honorable and ennobling to work somewhere and in some way, and he who thinks to live without it is an enemy to himself and a curse to society. Men are trying to ignore this law of labor so distinctly announced by our Creator, and so the fraud and the dishonesty, the speculations into which they plunge so recklessly, the public and private robberies so alarmingly prevalent, the almost inconceivable attempts to get possession of pecuniary means without rendering a fair equivalent.

The place to arrest this fearful evil is at our homes, by practice and precept, instilling different principles into the minds of the young. Work is the price of honorable success. I do not mean by this that the life of the boy is to be one of slavish toil and incessant delving from morning till night, through all the days of the week and year. Make the work pleasant; recognize the need of rest and recreation. Make home pleasant and attractive. Use your best efforts to have the boys feel that home is one of the pleasantest places for them; that the house was made for their comfort and enjoyment, even the sunniest side of it. Let the best outlooks be familiar to them; and that there can be home-efforts to attract, instruct and amuse, even in a healthy way, as well as from home. Let

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it be the endeavor to have the house and buildings and all the surroundings safe educators."

Now I hope here in Enosburgh that we will try to elevate our calling. Let us feel that we have a goodly heritage, the lines have fallen unto us in pleasant places; do our work in the best and easiest way, and our sons and daughters will come to the conclusion that Vermont is a good place to live in, and that the dearest spot on earth to them is "Home, sweet home."

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THE PRODUCTION OF MAPLE SUGAR IN VERMONT.

By E. R. TOWLE, West Berkshire.

Before proceeding with my subject proper, I will give some statistics in relation to the production and consumption of sugar in the United States. From a special report of the Department of Agriculture at Washington, I find that in 1860 the total consumption of cane sugar in this country was 415,281 tons, of which 296,250 tons were imported, and 119,031 tons of domestic production. Of molasses, for the same year, 47,318,877 gallons were consumed, of which 28,724,205 gallons were imported and 18,594,672 gallons of domestic production. This was just previous to the war, when the sugar production of the south had reached its highest point. Since then there has been a great change in the ratio of imported and domestic cane sugar, as will be seen by the following figures:

In 1876 the consumption of sugar was 638,369 tons, of which 561,369 tons were imported and 77,000 tons of domestic production. Of molasses 48,829,904 gallons were consumed, of which 36,459,504 gallons were imported and only 12,350,000 gallons produced in the United States. From this it appears that from 1860 to 1876 inclusive, the United States produced less than 13 per cent of the cane sugar consumed, and a little more than 21 per cent of the molasses. Putting it in another form, in 1860 there was raised nearly one-half the sugar that was consumed, or 500,000,000 lbs. against a total consumption of 1,200,000,000 lbs.; while in 1878 only 257,000,000 lbs. were made against a total consumption of 1,731,000,000 lbs. From these figures it will appear that in 1878 it was necessary to import 1,474,000,000 lbs. to supply our deficiency. At seven cents per pound this would amount to over $100,000,000. There are sufficient lands in the United States adapted to growing the sugar cane, it is calculated, to abundantly supply the demands of our people, if they could only be developed.

The consumption of sugar in this country is steadily increasing. In 1860 it was calculated that the amount of sugar for each person was 29.58 pounds, while now it exceeds 41 pounds, as will be seen from the following: The New York shipping list gives complete

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statistics of the sugar trade of 1879, and places the total consumption in the United States for that year at 821,896 tons of 2240 pounds, which, counting our population at 45,000,000, would make nearly 41 1-4 pounds for each man, woman and child. This amount is classified as follows: Cane sugar 775,196 tons, equivalent in molasses, 44,900 tons, maple sugar 10,000 tons; beets, sorghum, etc., 1800 tons. Eighty-five per cent of the cane sugar and molasses is imported, and reckoned at seven cents per pound would amount to some $110,399,097, as the sum paid to foreign countries in 1879 for sugar. There would seem to be no reason why, in time, there should not be a sufficient quantity of sugar produced in the United States for the wants of the people, and perhaps be made a profitable article for export. Why should we pay nearly $100,000,000 yearly for an article that can and should be produced at home? Aside from the sugar-producing lands of the south, that must yet be more fully developed than ever before, the production of sugar from a species of cane adapted to growth in the north is now being tested with some degree of success, and may be specially adapted to the west, if not to the New England states.

In France in the year ending sometime in 1873, 400,000 tons, or nearly 1,000,000,000 pounds of beet sugar was produced, and in the whole of Europe devoted to this industry, 1,130,000 tons. It is well understood that the raising of the sugar beet for the production of sugar is being undertaken in this country, and in portions of the New England states is attracting considerable attention. It is already demonstrated that the beet can be raised in our latitudes and that sugar can be manufactured from it, and the question now of most importance to the farmer is, if the cultivation of beets can be made profitable, as their production will involve a good deal of labor and a superior condition of the soil. Amount of yield per acre, facilities for the marketing of the roots, as well as prices obtained, will all have to be taken into consideration in calculating the profit or loss resulting from this industry. If our soil and climate should prove to be well adapted to the growth of the beet for sugar-making purposes, a new era will certainly have dawned upon our agriculture. But upon this part of my subject I will not now enlarge, but proceed to the consideration of the more important matter of the production of maple sugar in Vermont.

This is essentially a product of our state, indigenous to the soil, and is the source of a considerable income upon the farm. In 1878 the yield of sugar and molasses—of which but a small portion was of the latter—amounted to nearly 9,000,000 pounds, worth perhaps

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$700,000. Allowing this to be an average yield, it is not probable that the next census will show any great increase in the amount made, although there will doubtless be a greater difference in the proportion of sugar and molasses, from the demand for the latter, and the greater facilities for putting up and marketing it. Allowing 40 pounds to each inhabitant, which must be a low estimate for this state, it would require over 13,000,000 pounds for home use, an excess of 4,000,000 pounds above the amount manufactured. From this it will be seen that a large amount of foreign sugar is used in Vermont; how much is uncertain from the fact that a considerable quantity of maple sugar and molasses, or syrup, is annually sent out of the state and the demand for which is steadily increasing.

The manufacture of maple sugar in Vermont must date back to its early settlement by white people, and may have been carried on by the Indians previously. Of course for a long time the amount made was small and the process of manufacturing the most inexpensive and simple. I presume in some orchards in this state occasionally an aged maple tree may be found with the scars made by an axe in tapping by the method then known as "boxing." Wooden troughs were used for catching and storing the sap, and kettles for evaporating it, set out of doors and driven with green wood, cut as wanted for use. Wooden buckets succeeded the troughs, augers the tapping gauge and axe, store tubs the great log-holders, but for many years the large iron kettles were employed for boiling the sap, and are yet in some places. With these arrangements it required a good deal of care to make a fair average quality of sugar, while a considerable portion was more or less inferior in qmality. But in this industry, as in almost every other, great improvements have been made within the past 10 or 15 years. With the modern apparatus, consisting of tin, or nicely turned and painted wooden buckets, metallic spouts, well-made, convenient sap-holders and vats, improved evaporators or boiling pans, and excellent styles of packages in which the sugar or syrup can be put up for market, it would seem that a good article could be made, good enough for nearly or quite every demand of the household, or want of the trade. It is not my intention to go through with the *modus operandi* of manufacturing maple sugar and syrup, giving instead some hints and suggestions from my correspondence with successful sugar makers and dealers, in relation to this matter. My object in preparing this paper is to give a brief history of the maple sugar industry in this state, the improvements that are being made, the demand for the product, both in this state and outside, with the styles of packages in which the

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sugar and syrup are put up for the trade, the prospect for future development, etc., etc. A portion of this ground has already been covered and the rest will be gone over in the correspondence alluded to.

Mr. A. M. Foster, proprietor of "Maple Glen Sugar Works," Cabot, says in relation to questions propounded to him: "The bulk of my sugar is put in 40 pound tubs, and in tin pails holding from 10 to 25 pounds, usually fill about 100 10 pound cans of syrup and some 4 gallon kegs to fill orders, which pays the best. Also cake when ordered. My best market is at home, although I frequently receive orders from St. Louis, Chicago and other parts of the west. The demand outside of the state is increasing, but persons unacquainted with the details of sugar-making call for a poor grade, for fear of adulteration, it is said. There seems to be a prevailing error among otherwise intelligent people, that clean, white maple sugar is adulterated; therefore I think the present duty of maple sugar makers is to educate consumers up to a higher standard of excellence in regard to this product, inducing them to use the same nice discrimination in selecting their sugar that they do in butter."

It may appear a little strange to farmers that while a majority of consumers desire a really good grade of maple sugar, some of them, as appears from the above, are afraid of the finest qualities made, so clean, clear and white, suspecting adulteration, attributing to this cause the result of improved methods of manufacturing. I think the most effectual way of convincing such persons of the utter fallacy of their suspicions would be to let them test a sample of sugar made in the old primitive style, by a not very careful hand, and that would contain both color and flavor, along with the pure, concentrated sweet of the maple, as made by Mr. Foster and others. If any maple sugar is adulterated in Vermont by the manufacturers, it must be by those—if any there be, and I am afraid there are some of this class still left—who do not believe in the maxim that "cleanliness is next to godliness," and make sugar that is plentifully adulterated with dirt, ashes and coals of fire.

Mr. Curtis Wheeler, of Fairfax, says: "I tap 250 trees, use tin buckets mostly with covers, boil in an evaporator, gather and boil the sap as quickly as possible, and sugar off as soon as sufficient syrup for 50 pounds of sugar is obtained. For syrup boil down immediately to the proper consistency and do not heat again, as this would produce a darker color. Make on an average 5 pounds per tree, and put in tin pails, holding from 20 to 60 pounds, and also in cakes, weighing from 4 ounces to 3 pounds each. Put syrup in 1 gallon cans and send to Boston, to private families that I have

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furnished for 10 years, and expect to for some time to come. Get $1.25 per gallon for syrup, and 10 to 12 cents per pound for sugar. Have taken premium on syrup and sugar at state and county fairs."

Mr. G. S. Fassett, of Enosburgh, gives a good account of the sugar industry of that town: "There are several ranges of hills running north and south nearly through the town, on which are located a goodly number of fine sugar orchards, containing from a small number of trees up to 2,500. His own contains 540 trees, and makes from 1,800 to 2,700 pounds each year. Put in tin cans holding 1 gallon of syrup, or 10 pounds of sugar, and markets in Lyman and Athol, Mass., and in Connecticut, at good prices."

Mr. J. M. Whitcomb, of Enosburgh, is a large manufacturer of sugar, formerly having an orchard of 2,500 trees, but which is now reduced to 1,500, from which he makes an average of 4 pounds per tree. Make syrup for market mostly, put up in 6 1-2 gallon kegs and send to Lyman and Beverly, Mass. Thinks that the western demand is increasing each year. It is sent there mostly in tubs or cakes, as the freight is less and then made into syrup. Advises improvement in sugar houses and apparatus, and dwells particularly on the importance of evaporating the sap as quickly as possible, so as to make a finer article of sugar. Receives letters of inquiry every year from New Hampshire, Chicago and different parts of the west.

Mr. Geo. M. Stiles, of Jericho, has an orchard of 900 trees; makes syrup for the market, puts in 1 gallon tin cans, holding 11 pounds by weight, and sends to Chicago, New York, Buffalo and different parts of our own state, where he finds a ready sale. Makes 4 pounds per tree.

Mr. Wait Chase, of Fletcher, taps 2,000 trees and makes an average of 3 pounds per tree. Puts in brick-shape cakes, weighing 3 pounds, and some in small cakes, 10 to a pound. Has sold mostly to parties in the state, and sent some to Chicago. Uses the improved apparatus and obtains good prices. In his vicinity maple sugar is the leading production, and were it not for this farmers could not succeed.

In the eastern part of the town of Franklin, taking the farms just as they come for a distance of 4 miles in length, there are 7,030 trees that are tapped, and from which an average annual product of 16,700 pounds of sugar is made, or 2 1-2 pounds per tree. In the statements I have given, the above is the lowest estimate per tree, but this is from a large number of trees in different orchards, and the highest, 5 pounds per tree, which is a remarkably

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large yield. There was once standing—if not now—a large maple tree on the premises of Mr. B. Ladd, in Corinth, from which 20 pounds of sugar has been made in one season. I think this must be the largest yield on record. In some of the more older settled portions of the state but little sugar is made, and in others the amount is comparatively small; so that it will be seen that this is not a universal crop even in Vermont.

From the instances I have given it will be seen that the farmers named have improved apparatus, make a large amount of sugar and syrup, of a superior quality, for which there is a ready demand at good prices. A longer list might be given, but this is not necessary, and I will now refer to interviews and correspondence with *dealers*, to ascertain the *character* of the sugar purchased, its quality, how it is put up, where sold, etc. All will please bear in mind that the sugar now spoken of will embrace *all* grades, from the poorest manufactured to the best, and will give a tolerably correct idea of its character. From dealers in St. Albans: One recommends the 20 and 30 pound butter tubs for packages; good, clean tubs, as this is of more importance than most people are aware of. Ten, 20 and 30 pound tin cans would also make good packages. Has orders from Minneapolis and Chicago. Good sugar finds a ready market, the poorer grades sell hard and at small prices. A second buys mostly in 30 and 50 pound butter tubs which will hold from 45 to 75 pounds of sugar. Is of the opinion that the brick-shaped cakes would be best. These will pack nicely in boxes for shipping, as will also the square cans. A third has sold in Boston and New York, also in Minnesota and California. Finds some demand for syrup. Is in favor of the brick-shaped cakes. A fourth has lately had an order for a car-load from California, in bricks, but could not supply it; sells there for 25 cents per pound. Says there is a good deal of poor sugar made. Another merchant who handles quite a large quantity of sugar in his trade says: "Some of it is very nice, more of it poor, and a portion of it very black and dirty. While the average quality is much below what it should be, yet there has been a decided improvement in the past few years. Retails the larger part and best, and ships the balance to Albany, where it is made into candies. Tin makes the best and neatest packages and the sugar retains its flavor more perfectly than in tubs. Should say that the demand west is increasing, and that it sells for about an average of 10 cents per pound. Would advise the manufacture of more maple sugar, but would urge the importance of making a better article, that is, generally, as that of a good quality will sell readily at satisfactory prices, and the poorer grades

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are difficult to dispose of at any figure." Mr. S. K. Quimby, of Lyndon, considers the sugar question of more importance to farmers than they are aware; will pay them better than some other branches of their industry, and he advises them to tap all the trees they can, and make just as good an article as possible and there will be little trouble in disposing of it. Says there is a large amount made in that part of the state, and mostly of the kind known as "dry or stirred sugar." Buys and sells large quantities of sugar, some in tubs and some stirred or granulated, in barrels. Tubs holding from 50 to 100 pounds, with good covers, are recommended, and he further says that the sugar should be thoroughly cooked, hard enough so that it will go through the warm weather without softening at all. Stirred sugar should be put in clean tight barrels, headed up and kept in a dry place—not in a basement or cellar—as it will sour, or the peculiar maple flavor become changed under such conditions, which it is very desirable to avoid. Is of the opinion that the western demand will continue, and that Vermont farmers should be able to supply it so far as possible.

A few years since a merchant informed me he calculated that sugar as then caked, if kept through the warm weather, would shrink about 20 per cent in weight, and it was necessary to take this into consideration in regulating the selling price. Another dealer in speaking of caked sugar found that if put in a mass together the drainage of molasses would be considerable, but if piled up in form like lumber, with narrow slats between the cakes, the air would then circulate through and prevent the leaching.

I think I have now gone over the principal points contemplated in this paper, and will hasten to close, as it is already getting too lengthy. I find that there is a great variation in the capacity of different orchards, either for the production of sap or sugar, some yielding more sap than others, or of a greater degree of sweetness. This generally is either owing to the location of the orchard or the age and condition of the trees. Evergreen trees should not be allowed to remain in a sugar orchard, nor should they surround it, at least in close proximity, as the effect is bad; neither should there be too many other kinds of trees inclosed, as the maples should have plenty of room. Would not have the orchard too much surrounded with forests, but open as much as may be to the sun. I find that orchards located on either dry or low land produce good results, but should prefer the first condition. I believe it is generally considered that good second growth maples produce the sweetest sap, and as the old ones fail the thrifty, growing trees should be carefully saved for

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future use. By selection of this kind and reasonable care the orchard may be kept in an improving condition. Farmers having extensive orchards will find it profitable to fit them in good shape for business, and make as much as possible of a superior quality of sugar or syrup; and in relation to the market for the same, putting it up in such shape as the trade demands. I would advise also as to the propriety of looking up a good market, as some of the gentlemen referred to have done, and furnishing a supply of such a character as will defy competition. Where a large quantity is made, unless regular customers are secured, sugar makers will usually find it to their advantage to dispose of that first made, when the demand will be better than later in the season. As was observed by one dealer, there is a large amount of inferior sugar made in Franklin county, notwithstanding the excellent facilities for manufacturing possessed, and I hope that a proper agitation of the subject will lead to a more decided improvement in the future, and that not only will the quality be improved, but the quantity made increased to such an extent as to supply the demand of our own state, at least. With proper management I believe this can be done and an article furnished of such excellence as to do away almost, or entirely, with the necessity of purchasing foreign sugars for any of our domestic requirements.

I would further add: The manufacture of beet sugar may become profitable in some portions of the country—perhaps even in Vermont; but this industry is yet an experiment, and will require time, persevering effort and capital in its development, even should it prove all that is hoped or expected of it. The same perhaps may be said of the "Minnesota early amber sugar cane," which is now receiving the attention of scientific men and agriculturists in this country; it may be eminently successful; it may not; the future alone can determine this; but of one thing we may rest assured, maple sugar making is not an experiment, its production is time honored, there need be no probability of its failure, while the future should witness a satisfactory increase in quality and quantity, rendering it truly a favored product of our own Green Mountain state.

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THE ART OF AGRICULTURE.

A PAPER READ BY MRS. RODNEY STURTEVANT, AT THE EAST FAIRFIELD FARMERS' MEETING.

Agriculture, the mother of art, the oldest and most esteemed of all arts, has made such progress in the last half century as to claim the attention of the wealthiest and most intellectual men of the age. As ranked with the fine arts, it demands the same power of intellect, study and common sense, especially to carry it forward to perfection. While the poet, the painter and the sculptor, by their beautiful productions of inanimate objects, elevate and refine our inner sense of the beautiful, the agriculturist reproduces, by his skill and knowledge of the science of nature's laws, perfect animals, filled with life and animation, which not only call forth our enthusiasm of admiration, but supply us with the sustaining elements of our existence.

Therefore, agriculture is not only beneficial to mankind as an experiment, affording pleasure and employment, but the great essential of life itself. If all the poetry, painting, music and sculpture made by man were blotted out from the earth, yet mankind could live and be happy, for there would yet remain the glorious sunsets, the beauty and perfume of flowers of every hue, and the songs of birds to cheer and gladden; nature's works, which seem to mock at art, and in defiance of her power, by random strokes perform such inimitable feats, as she with all her rules can never reach. But if the farmer should neglect to till the ground and sow the seeds for one single year, destitution and distress like a pall would envelop mankind; for, as Emerson has beautifully expressed it, "The agriculturist stands at the door of nature's store-house, dealing to each his loaf." Mankind's greatest needs should, therefore, call forth his largest amount of energy, concentration of thought and directness of skill. Agriculture is the backbone of the national prosperity; upon it depends all intelligent culture and is made tributary to its demands. The skill of the mechanic in providing its utensils and labor-saving machines, the science of the laboratory in testing seeds preparing fertilizers, analyzing and combining properties necessary for plant growth, and all other classes contribute of their stores in exchange of its productions. The star of its empire is still rising in the western continent, and the hungry, starving nations of the

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east are reaching out their wasted hands for bread, which must and should be an incentive to redoubled energy in the production of food for the masses of mankind, who, through incapability and ignorance, are unable to provide for themselves.

These United States, with her thousands of acres of as yet uncultivated land and millions under subjection, invites and brings out all the powers of man, both of the head and hands. New England, mountainous and rock-ribbed, with a climate so adverse a large share of the year, and a soil unproductive to a considerable extent, without skilled labor, yet with it and the aid of science, wonderful results are accomplished. She has ten thousand volumes in her libraries, treating on agricultural subjects, in connection with her agricultural colleges, state boards and dairy meetings, which are proving to the world that farming is not a low calling, fit only for men without brains, but an art befitting its advocates to stand before kings. The successful agriculturist honors his calling and strives for perfection in all he undertakes. He has left the deep-worn ruts of his forefathers, and has cast aside the superstitions and worn-out theories of the past generations. He comprehends the necessity and demand of a fine perception, and master strokes of wisdom and skill, to bring out and fully develop the grand principles of this art. He does not believe in chance or mere luck, but that industry, perseverance and a thorough knowledge of his business will bring its reward. He is ever on the lookout for new ideas, and putting in practice day by day recently developed theories that appeal to his common sense and unbiased judgment, taking particular interest in agricultural literature and farmers' meetings, thus by an exchange of thought and experience becoming cultured and skillfully able to conduct his business successfully and add to it that dignity to which it is entitled. There are not any works of the masters in the art of agriculture of the past that can be imitated or copied from, for the present has swept them far away. Even its history is deficient and almost worthless, and of no practical use. The present and future generations are to establish it in the prominent and exalted position to which it rightfully belongs in the eyes of the world. This art furnishes the largest independence of all the occupations in which men are engaged. Men in this profession deal and confide in nature and her immutable laws, which are far more reliable and trustworthy than Wall street stocks, or dependence upon fellow men in general. For it has been declared that "whatsoever a man soweth, that shall he also reap."

Agriculture, like every technical pursuit, is based upon experience and a knowledge of science; the wider the experience, the greater

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the knowledge, the more perfect and satisfactory the results; and so wonderful has been the progression in this art in the past 30 years, that a writer on the subject designates it as a "New agriculture." There are new kinds of corn, wheat potatoes and oats; new breeds of cattle and horses, pigs and sheep, more perfect in form, more profitable in production; new labor-saving utensils, enabling one man to perform in one day the work that required many days in the past by the old methods. It was the work of the forefathers to subdue the forests and clear the land, and they had little time or use for scientific research. But the increasing demand for food of the present century increases the necessity of acquiring a knowledge of how to supply it, and the results that have already been attained in agricultural art would seem to those fathers, could it have been foretold, like a fairy tale of the Arabian Nights. Where 20 to 40 bushels of corn were considered a good yield 40 years ago, 70 or 80 is now but a fair yield. It has become an established fact that farming cannot be carried on successfully without brain work.

The Chinese put their dullest boys to work on canals, while their brightest ones are employed in cultivating the land, an example which might be well for some of us with remarkably bright boys to consider. No man engaged in this pursuit should be satisfied with moderate or poor productions, but use all available means to produce the best; make the best butter and cheese, keep the best stock and do all things in the best time and manner. With the fertile soil alone agriculture is not perfected, but by the combination of industry, science and skill, united with natural advantages. Farmers, make your business a fine art; magnify it with your skillful management; bring it up to the standard you wish it to occupy and not allow it to debase you to the level of a mere drudge. Give mind to your business as well as hard labor, until you have made it conform to your desires, and avoid the ways of the slip-shod, hap-hazard class, who neglect the most important part of their business, which is a thorough knowledge of its details, and then grumble that farming doesn't pay in Vermont, leaving the mine of gold they possess in their farms unsought for, and therefore forever hid from their view. Let us lead our sons and daughters to appreciate this pursuit, by the culture and interest that we may apply to it, and then they will be encouraged to follow out, and go far beyond even, what we were able to perform.

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A CHANGE IN FARM SYSTEM DEMANDED.

By J. W. SANBORN, Superintendent of the College Farm, Hanover, N. H.

It is customary among agricultural writers, orators and teachers to assume as a fact and inculcate as a duty the assumed fact, that agriculture in New England is remunerative as a whole.

The census of 1870 revealed the fact that the rural population of New Hampshire fell off the previous 10 years upwards of 20,000. The rural population of Vermont had not then suffered so severe a decline as in New Hampshire. The markets have so changed since 1870 in the products that interest Vermost most that to-day, judging from favorable means of reviewing the present condition of your agriculture and the present feeling among your farmers, there is as much unrest and dissatisfaction among your farmers as ours; and that there is as full a tide of emigration from your state.

Do merchants in the fullness of their strength abandon a lucrative business without a fair compensation for goods and trade? Do bankers, with capital unimpaired from any cause and while good semi-annual dividends are being declared, sell their stock for fifty cents on the dollar? Do flourishing manufacturing corporations allow a crumbling edifice to cover an idle water wheel while yet the general business is good in its line? Was there ever in the history of the world a healthy business in a normal state of society that for a long time failed to have all of its units in active operation?

The law, substantially immutable, that the relative demand for the property of a legitimate business offering no great hazards is measured by the profits of the business, makes of the deserted farm homes all over New England proof positive of a decline or unsatisfactory condition of our industry. I state my conviction without hesitation, based upon personal knowledge and careful review of the situation of our farming interest, that the present condition of farm industry as a whole, in New England, is not satisfactory. And furthermore, that if the present system of farming is maintained in the future it will grow more and more unsatisfactory for a generation to come.

The decline of the individual generally follows that of his industry; therefore the interests of the individual and the state demand that

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our farmers should either achieve success in their business or change it, else change locality of doing it. This may not seem like farthering the object for which your able superintendent is so zealously laboring. A man who recognizes his true position with reference to the forces with which he deals, especially if the situation is a perilous one, not only is better prepared but more certain to act and to act promptly and effectively than one either willingly or ignorantly blinded.

We may deny facts, but facts will remain to plague us with more force. If not as brave men, then as prudent men, there is no other wise course open to us but to look the facts full in the face, however ugly the face may be. We shall certainly see good farms sold for less than the costs of improvements on them while keen-eyed capital looks on and bids not, although each sale the bids go lower and lower; and we shall certainly see the business avoided by the young man, although the paternal acres await him, as it is not avoided in other sections of the country.

A HOPEFUL FUTURE.

Gentlemen, I have but spoken my convictions thus fully for the definite purpose of enforcing the necessity of an early and wide departure from the traditional methods that we have inherited. I mean no disrespect to the fathers. Their methods were such as the knowledge of the day admitted and the conditions existing demanded. The development of agricultural knowledge, of labor-saving implements, and the present relation of the west to the east, are changes so vast as to call for a revolution in our farm practices. The means to success obviously are not those by which we have lost in the contest. Many of our farmers are recognizing the fact and are improving their methods, and are looking anxiously for the direction in which to move. It is upon this change that I desire to throw out some facts and suggestions both for the purpose of accelerating and, if worthy, of giving direction to the movement.

I am satisfied that New England farmers are about to enter (the bolder spirits rapidly and the general farmer gradually from imitation) an era of farm prosperity never before known in the history of our agriculture; that the social, intellectual and financial standing of the farmer will be greatly advanced, and in all the elements that go to make happiness and prosperity the New England farmer will, ere long, stand first among the farmers of this broad, rich country. For profitable culture, I should rather to-day own a good New Eng-

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land farm than a similar one in the west. Thus it is the "what is," not the "what may be," that I would discourage.

A SYSTEM FOR SUCCESS.

For 25 years the watchword has been small areas well tilled; or, as we would put it, contracted farming, though deep. The answer to this cry has been a decreasing farm population and price of land. Uniting boldness with skill, our watchword must now be large areas well tilled, or broad and deep farming. I would carry this policy so far as to include, as is the case in England, at least 50 per cent of the arable land constantly under the plow. In many cases I would keep most the land of a farm that would admit of plowing, in other crops than grass, not including clover as a grass crop. Thus I would expect to multiply the gross revenue of the farm by 3 or 4 times and make a possibility of profit where none now exists, for the gross revenue of an average farm would hardly satisfy a merchant of average ambition. Now, can a farmer out of an average income pay for some help, taxes, repairs, keep of team, repair of tools, insurance, household expenses and education of children and be satisfied with the remainder, should there be any, for profits after paying his own labor and interest on capital invested?

I am told by good farmers in some of the best grass towns of the state that a ton of hay per acre is fully as high as the average yield, and that it is selling at the barn for $8 per ton. Suppose an average farm to contain 40 acre of field land; if all in grass the crop in the barn would bring the magnificent income of $320 gross. Such a farm usually has three to four acres of corn, a few of oats and an acre of potatoes, the gross value of all which is less than $500 when harvested. It is a necessity of our soil that most of these crops be fed upon the farm for the resulting manure, and excepting for butter, into which more labor has to be put, farmers claim that not two-thirds of the market value of the food is realized, in feeding, from animal products.

In short, the possibilities of a system of farming that makes grass so prominent a feature in Vermont are not encouraging where the price of hay is low and the average returns less than the rent of an English acre. The gross value of the crops of the supposed farm of 40 acres field land must by tillage be brought from $500 to from $1,500 to $2,000, and a possible net revenue to strive for. There are farmers present whose farms are capable of yielding a gross revenue of from $4,000 to $7,000 and a handsome net income. In

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England where wheat is the great crop grown (selling but little higher than wheat in your villages) it is not uncommon for farmers of 200 to 450 acres reporting gross revenues of from $10,000 to $25,000. While English practices may not be relied upon to enforce American practices, yet they may serve to stimulate our ambition. In this advice I am preaching only what I practice. Like the merchant, then, let us seek to constantly enlarge our business, remembering that a small and narrow business means small and narrow profits.

HOW TO ACCOMPLISH CHANGE PROPOSED.

1st. By the free purchase of foods rich in plant nutrients, to feed to enlarged herds of cattle, sheep and swine, for the resulting manure.

2d. In the free purchase of chemical manures.

3d. In establishing a systematic rotation of crops.

4th. In the free use of labor-saving implements.

5th. In the free use of capital, necessarily following the factors proposed.

Such a scheme requires intelligence and skill of a high order. Other things being equal, the man who understands the laws of his business best works to the best advantage. Our farmer will know more of the science of feeding, plant-nutrition, laws of tillage, soils, etc., etc. Carrying on a large business, he will be the director rather than the executor of work. He will have to be an executive as well as an intelligent man. Our farmer then will be a broader and fuller man, commanding more the respect of business and intelligent men of other industries.

Should a broader financial success follow, fuller libraries, better furnished homes, and all the auxiliaries to it would follow, including well educated sons and daughters. Then will our sons and daughters be attracted to this industry. The farmer's sons and daughters have latent tastes anxious for, and capable of, stronger development; and ambition larger than those of any other large industry. They should not and will not be attracted to the industry of farming until the resources of the farm are broad enough to give them those refinements and luxuries that are a part of the civilization of the day. I have no patience with the advice to farmers to be economical. We want to see no economy for farmers that others do not practice.

I doubt not that I ask more for the coming farmer than you expect, and promise more than you believe in. The methods proposed to accomplish the results are so antagonistic to the conservative practices in vogue that I doubt not they will invite what I desire, your severe criticism. Your superintendent has allotted me an hour each

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for this afternoon and evening. I propose to use the time in reviewing each step in the process proposed in the endeavor to show that the scheme suggested is founded upon sound farm practice and sound farm law. I shall very rarely if at all allude to laws governing in any department of our industry unless they are rooted and founded in exacting farm experiments; nor shall I, nor have I, advised any farm practice that I am not endeavoring to carry out in actual farm practice, not only for the public but for, or upon, my own farm. My apology for this personal statement is the not uncommon belief that farm science is a sort of "hocus-pocus science, which, while it smiles in our faces, picks our pockets." While early theorists by inductive reasoning from a few facts led farmers into grievous errors, and thus brought scientific farming into contempt from which it has not yet recovered, it must be remembered that to-day the cautious investigator rests all upon the chain or scales, and thus we have principles in agriculture that rests upon firm foundations. He, in farming, who ignores farm facts (not fancies) sins against himself and throws away much of his chance of success.

PRINCIPLES IN STOCK FEEDING.

No more important fact can be recognized in stock feeding than that laws control in this branch of our industry as immutable as those that maintain "the music of the spheres," the breaking of any of which has its penalty in loss of profit to the feeder. The rule of thumb method of feeding does and can only bring loss to the feeder. The observance of fixed laws in animal growth and nutrition will enable us to feed our home grown and purchased foods, and realize the market price of such foods when fed to either pigs, sheep or steers. Indeed, I should not dare to advise the feeding of more stock, and especially on purchased foods, were it not for the recent and trustworthy advance of knowledge in this growing science. It is not my purpose to go into a discussion of the nice points of animal nutrition, but to review briefly those fundamental principles of animal nutrition not fully recognized in general practice, upon the observance of which rests our hope of success in the meat products of the farm. I shall consider the subject in the following order: Feeding for manure, the animal to feed, early maturity, science of feeding, cost of feeding.

FEEDING FOR MANURE.

The factor of greatest importance to the majority of New England farmers, is domestic animals as a source of manure. No manure, no crop. Farm animals the cheapest source of manure. Again, steers,

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pigs and sheep are kept, not for direct profit from sale of flesh, but as a necesity to obtain the profit from the use of the resultant manure. Then our animals are kept as manure manufacturers. The first question then, in stock feeding, is the manure value of the food given; for the food that will make a pound of growth cheapest is not by any means the cheapest food that a Vermont farmer can buy. The calculation of the manurial value of a food, always and first, enters into the purchase of cattle food by an Englishman. It is one of the most unfavorable comments upon the low condition of our agriculture, that such a calculation never enters in, except in rare instances, to our purchase of feeding stuffs. I advocate the free purchase of cattle foods, rich in plant food, as the cheapest source of manure to fertilize the broadened areas of tillage land proposed; and will attempt to show that the feeding can be done profitably. If so we may have an unlimited source of plant food.

The manurial value of a food is estimated upon its content of nitrogen, phosphoric acid and potash. Enormous amounts of commercial fertilizers are now annually purchased, and for every pound of phosphoric acid bought 12 1-2 cents is supposed to be a fair price—20 to 25 cents per pound for nitrogen and 4 1-2 to 9 cents for potash. A ton of corn contains 32 pounds nitrogen; it contains 7 2-5 pounds potash and 11 4-5 pounds phosphoric acid. At the prices and amounts given, as an illustration of the point I would impress, a ton of corn would contain the materials that would cost in fertilizers, in round numbers, $10. In feeding a part of these materials (not 1 pound in 10) goes into growth and another fraction from various causes is lost, so that after feeding, that eminent authority, Dr. J. B. Laws, estimates the manure from a ton of corn meal to have a value of $6.65. On the basis of estimating outlined by the same authority, the manure from a ton of

Linseed cake	is worth	$19.72	Potatoes	is worth	$1.50
Cotton seed meal	is worth	27.66	Turnips	"	86
Indian meal	"	6.65	Bran	"	14.59
Clover	"	9.64	Malt dust	"	18.21
Hay	"	6.43	Peas	"	13.86
Oat straw	"	2.90	Middlings	"	13.63

It cannot safely be said that the manure from a ton of corn meal is worth $6.65 to grow crops with, but it can be said that if the manure from a ton of corn meal is worth $6.65, then from cotton seed meal it is worth $27.86, and from bran $14 59. On the supposition that a ton of middlings will make as much pork as a ton of corn meal, would it not be narrow and short-sighted policy to buy corn

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meal, the price of the two being the same? In fact, as the result of 3 years' experiments with scales and pigs, I affirm that I can get 15 per cent more growth from a ton of middlings than from a ton of corn meal, the difference in value amounting to $10 per ton of food in favor of middlings. This winter a ton of cotton seed meal costs but little more than a ton of corn meal, yet I know that a ton of the former rightly fed is worth more than the latter and the manure 4 times as much. And yet our fields are famishing for want of manure. Even our best farmers, who pride themselves on their rich farms, have not approximated to the possible yield of these farms. But, as I promised, I must, if I would establish a good sound case, rest all upon practice. A volume might be filled of successful results from the use of foods rich in manurial elements as fertilizers direct. While the practice is not common, especially in this country, yet it is full enough to establish beyond question the general fact that chemistry indicates. In Enfield, N. H., adjoining my own town, the farmers are in the habit of using bran as a corn fertilizer, and report that it is cheaper than fertilizers and effectual. I have used cotton seed meal 2 seasons in accurate field experiments and found this food a fertilizer of profit in use, giving me 51 1-2 bushels corn of 80 pounds per bushel, also 6,900 pounds stover. A nothing plot (or no manure) gave 33 bushels and 3,600 pounds stover. I used 1,000 pounds meal, costing $15.00; this result compared favorably with other manures. A large stock bed with rich manure making foods is one of the highroads to great crops and successful farming, provided we can sell our foods to steers, pigs, sheep and cows at market rates. To do it we must begin with the

RIGHT ANIMALS,

which term covers the well bred animal, or, in other words, an animal that inherits large powers of digestion and assimilation. It is not my purpose to discuss the science of breeding; only to insist that the good animal is of vital importance to us if success is to be achieved. It is impossible to work up cheap products with poor machinery. The particular point that I would call attention to is that the poorer animal responds less to good feeding. As Dr. Sturtevant would put it: "There is a structural limit to the production of each cow." "When a cow is fed to that limit increased food will not increase the product." "The superior cow has this structural limit at a greater distance from ordinary food, and is more ready to respond to food than the inferior cow." Animal may be substituted for cow and the same important law will cover it. An

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animal may, under the physiological law quoted, when fed high, eat more than it can digest and assimilate; but the poor animal will to a far greater degree than the good one. In fact, the poor animal has not the capacity to digest and assimilate food enough to make it possible to breed it at a profit in New England. From my experiments at our college farm where I have had occasion frequently to vary the food, I find that when I increase the grain feed to various cows the better cows respond more fully than the poorer ones. While the fact is generally recognized that a good animal is more profitable than a poor one, yet the general stock of the state is evidence that the fundamental difference is not appreciated even after making due allowance for the fact that none of us do as well as we know. We come nearer right in our "resolutions than in our actions." I think that more than other industries ours suffers from the inertia of its votaries. "A work prospers through endeavors, not through vows."

Another rule to remember is that large animals expose less surface for radiation of heat in proportion to weight than small ones—somewhat on the principle that, density being the same, the weight of circular bodies increases as the squares of their diameters. From an experiment in feeding 3 small animals or animals of small breeds, against 3 Durhams, for 112 days, I conclude with what I suppose to be the belief of most good breeders, and what is agreeable to theory, that the large breeds make a pound of growth on less food than the small ones. For beef, my belief is strong that the cross bred steer of the larger breeds is the farmer's steer. I would not apply this law to the hog because the larger breeds of hogs lack shape and completeness while yet young; and to select the large breeds of hogs would bring us into conflict with another law of annual growth to be noticed.

EARLY MATURITY.

We may lay it down as a law, without exceptions, that young animals require less food to make a pound of growth than older ones. Early maturity of the animal products intended for flesh is an end of vital importance to the farmer. No beef can be made to-day at a profit in Vermont, or except at a loss, that is not made young. Young animals consume more food in proportion to their weight than older ones. Their organs concerned in digestion and growth are more active, and turn this excess of food consumed into growth. Whatever the reason for the facts, nothing but an uncompromising adherence to them for a moment should be thought of.

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So disastrously ignored, and of such importance is the subject, that I surely cannot err in giving details from a few experiments of the many in my possession:

SHOW CATTLE AT ISLINGTON, ENGLAND, 1879.

7	Shorthorns,	average growth per day to or not exceeding		2 1-2 years,	2.06 lbs.
15	"	"	"	2 1-2 to 3 1-2 years,	1.79 "
8	"	"	"	3 1-2 to 4 1-2 "	1.62 "
8	Herefords,	"	"	2 1-2 years,	1.91 "
12	"	"	"	2 1-2 to 3 1-2 years,	1.70 "
4	"	"	"	3 1-2 to 4 1-2 "	1.44 "
7	Sussex,	"	"	2 1-2 years,	1.88 "
6	"	"	"	2 1-2 to 3 1-2 years,	1.73 "
4	"	"	"	3 1-2 to 4 1-2 "	1.65 "
7	Devons,	"	"	2 1-2 years,	1.52 "
9	"	"	"	2 1-2 to 3 1-2 years,	1.27 "
6	"	"	"	3 1-2 to 4 1-2 "	1.21 "
Cross bred steers,		"	"	1,025 days,	1.90 "

To the student of stock feeding this table will suggest several things of interest, but for my purpose here is an array of facts strong beyond doubt to prove my point. While the heavier and older animals must beyond question eat very much more, as common sense will teach, and the following figures emphasize, they actually grow less on this heavily increased consumption: E. W. Stewart fed 10 calves with milk in periods of one week each. The 1st period it required 11.02 pounds milk to make 1 of growth; 2d period, 12.18 pounds; 3d period, 13.17 pounds; 4th period, 13.40 pounds; 5th period, 14.60 pounds; 6th period, 15.05 pounds; 7th period, 16,71 pounds; 8th period, 16.80 pounds; 9th period, 17.01 pounds.

With thrifty pigs 6 weeks old I found it took for the 1st month 9.8 quarts skim milk to make 1 pound of growth; next 39 days, 11.3 quarts; 41 succeeding days, 15 quarts were required to make 1 pound of growth. Again, 2 calves ate 3.5 per cent of live weight daily and required 7.7 pounds hay to make 1 of growth; 6 calves 8 months old ate 2.8 per cent of live weight daily and required 12 pounds of hay to make 1 of growth; 5 lots of year-olds ate 2.6 per cent of live weight daily and required more than the year-olds to make 1 pound of growth; 8 lots of 2-years-olds ate 2.16 per cent of live weight daily and required more than the 2-years-olds to make a pound of growth. Again, I fed 2 calves 6 periods of 2 weeks each and kept weights of calves and food consumed. December 16th to 30th—gained 63 pounds, fed 20 quarts skim milk daily and 1 pound meal; December 30th to January 13th—gained 59 pounds, ate 18 quarts skim milk, 2 pounds mixed meal and 4 pounds hay daily; January 27th—gained 71 pounds, ate 20 quarts skim milk, 2 pounds meal and 5½ pounds hay daily; February 10th—gained 60 pounds, ate 20 quarts skim milk, 2 pounds grain and 7 pounds hay

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daily; February 24th—gained 63 pounds, ate 20 quarts skim milk, 3 pounds grain and 10 pounds hay daily. The last period it took 10 pounds of hay and 2 pounds grain more daily to make the same growth as at the first. From my records of college farm experiments that I have carried on for the last 3 years I might pile up the facts, but these must be enough. It costs twice as much to make a pound of growth on an animal approaching maturity as on a young one. It is not entirely a question of age but of size also. The size must stop when it will bring a good price. We shall not err in getting that size at as early an age as possible. An average Vermont steer will not dress at 5 years of age more than 800 to 900 pounds. If you please to call the live weight of such an average steer 1,500 then he will have averaged in round numbers 800 pounds, for he will have started at say 75 pounds. Now I find from my books that such a steer will consume 1.8 per cent of live weight daily to maintain existence without growth or loss. Had the steer been made to weigh it at 2 years, or say 30 months, then the maintenance fodder would have been saved for an 800 pounds steer, a saving that makes a vast difference in the profits of steer raising. It is not strange that steer raising is unsatisfactory in the east, but rather that, ignoring the important facts in practice, it has an existence under western competition. For profit good beef must be raised under 2 years and pork within 7 months.

SCIENCE WITH PRACTICE IN FEEDING.

In no department of animal growth have investigators achieved more for the farmer than in unfolding the distinctive functions of the different parts of a food in nutrition. Not that exact truths have been clearly defined in all the boundaries of this important field of inquiry, but general laws have been outlined in sufficient fullness to afford a basis of a more economical system of feeding, broad enough to be of very great importance to farmers. To the Germans, Gilbert and Lawes, Bossingault and others we are deeply indebted for original investigation. Dr. Atwater and Prof. S. W. Johnson have rendered valuable assistance to us in placing before us the result of German work. Very briefly stated, the practical side of the question, as put by science and corroborated by a vast amount of practical feeding experiments, with the honest steer, who "cannot tell a lie," indicates that there must be a certain relation between the albuminoids and carbo-hydrates, of a pound of food for the best results. This ratio varies with the age and purpose for which an animal is kept.

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From the report of the Connecticut experimental station for 1879, I select a few facts from a table translated from German results, based on actual feeding experiments. For every pound of digestible albuminoids eaten, a proper food ration should contain for milch cows, 5.4 pounds carbo-hydrates; oxen at rest in stall, 12 pounds; at hard work, 6 pounds; growing cattle, 2 to 3 months, 4.7 pounds; 6 to 12 months, 6 pounds; 18 to 24 months old, 8 pounds; growing pigs, 2 to 3 months, 4 pounds; 5 to 6 months, 5.5 pounds; 8 to 12 months, 6.5 pounds. For the amount of these food constituents actually consumed per day and the amount of each contained by the various food materials, I shall for want of time have to refer you to other papers. My purpose is served in calling your attention to the relation of these investigations to economic farming, and illustrating from immediate practice the value of the law of feeding, to you.

In passing, I may briefly state that the albuminoids go to build muscle, or lean meat, tendons, tissues and membranes, while the carbo-hydrates produce fats, force, or work, support respiration and maintain the heat of the system. Carbo-hydrates cannot do the work of the albuminoids—life could not be sustained with them alone. Albuminoids can in a measure perform some of the offices of carbo-hydrates, but not economically. Oat straw, corn fodder and swale hay are poor in albuminoids, but have a normal amount of carbo-hydrates. A steer in eating oat straw finds only 1 pound of albuminoids to 30 pounds of carbo-hydrates; failing to get albuminoids, flesh-formers, enough, he fails to grow, in short, it is impossible that he should long grow, for an animal cannot long grow unless all his parts grow together. Fortunately, while we have the three foods so abundant among us, and of so low popular value because of exceeding small proportion of flesh-formers, we also have foods over-rich in flesh-formers, or albuminoids, like cotton seed meal, blood, fish, bran, middlings, peas, oilcake and clover hay. Science, then, simply says to us when feeding straw of the various grains, swale hay or corn fodder, sadly deficient in flesh-formers, the former two especially, feed also cotton seed meal (albuminous foods) or flesh-formers, and thus supply the lacking material in straw, etc.; then your stock will grow and the carbo-hydrates of straw, formerly in part wasted, will now he utilized and straw and swale hay have a practical value never before ascribed to them.

FEEDING EXPERIMENTS.

Facts take a stronger hold of us than speculation; one fact is worth a long array of theories. Wishing to bring the importance of

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law in feeding before our farmers in a practical form, I have on our college farm for four years, with cows, pigs and steers, pursued this matter of food combinations. To enforce my point in a practical form I give this table, taken from my report to our trustees, of results for last winter, prefacing it with the statement that everything in the experiments was carefully done, steers being selected of like ages, weights and breed, and food daily weighed and recorded. The hay was analyzed by Prof. Johnson; the swale hay, meat and cotton seed meal by Prof. Collier at Washington.

Lots.	Time in Feeding.	Foods Given.	Amount of Food.	Digestible Albuminoids.	Digestible Carbohydrates.	Digestible Fats.	Ratio of Albuminoids to Carbohydrates.	Gain.	Cost of Food for Seventy Days.	Value of Straw compared with Hay as Result.	Value of Swale Hay compared with Good.	Manure Value.
	Days.		lbs.	lbs.	lbs.	lbs.		lbs.				
1	70	Swale Hay,	2496	79.87	1239	31.20	1 to 5.1	167	$15.04	.....	86 p. ct.	$12.80
		C. S. Meal,	560	207.00	74	49.00						
2	70	Good hay,	3536	146.00	1803	34.00	1 to 12.9	185	21.21	.....	.....	11.36
3	70	Straw,	2423	34.00	971	17.00	1 to 21.3	120	9.53	1.26	.....	4.60
		Corn meal,	347	25.00	237	9.00						
4	70	Oat straw,	2310	31.00	926	16.00	1 to 6.3	81	12.74	.96	.....	8.60
		Meat scraps,	280	134.00	.....	11.00						
		Corn meal,	67	5.00	46	1.70						
5	70	Oat straw,	2450	34.00	982	17.00	1 to 5.8	133	13.88	1.00	.....	9.08
		Blood,	280	151.00	.....	1.40						
		Corn meal,	146	11.00	100	3.70						
6*	77	Clover rowen,	1694	118.00	645	20.00	1 to 9.1	144	12.21	1.65	.....	10.55
		Oat straw,	1309	18.00	525	9.00						
7*	56	Clover rowen,	1400	98.00	533	17.00	1 to 8.4	120	5.60	3.00	.....	6.79
		Oat straw,	840	12.00	337	6.00						
8	70	Good hay,	3206	135.00	1666	32.00	1 to 12.9	63	19.59	.....	.....	10.49
9	70	Good hay,	2688	111.00	1118	26.00	1 to 10.5	114	22.03	.....	.....	10.61
		Meal,	591	43.00	403	15.00						

*Average of several experiments of lots of from two to six steers, covering time of from 21 to 77 days; for comparison it is figured in lot of two, as the others.

PRICES OF FOODS IN THE ABOVE TABLE.

Meat scraps and dried meat, $45 per ton; dried blood, $45 per ton; straw, $5 per ton; corn meal, $20 per ton; good hay, $12 per ton; clover hay, $12 per ton; and swale hay, $6 per ton.

The basis of the column of amounts of digestible food was derived from percentages given by Wolff, as the result of feeding trials.

The corn meal eaten by lots 4 and 5 was for the purpose of teaching those lots to eat their blood and meat.

The amount of digestible materials given for meat scraps is as-

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sumed to be about the same as in the case of fish scraps, as given by Prof. Johnson in report of Connecticut experimental station.

Lot 7 was fed clover rowen that I bought for $5 per ton. It was a coarse sample, late cut. I introduce the result here to show more clearly its value. By estimating the clover rowen at its cost, it will be seen that a pair of steers, weighing 2,100 pounds, were fed for 8 cents per day when the food was mixed with straw. At the same time the steers made a very good gain. It cost 28 cents per day to keep a pair on good hay, the steers making only about one-half the growth of those on straw. Of course $5 per ton is an unnaturally low price for clover rowen. I think our farmers do not appreciate its value when rightly fed.

Passing to a just basis of comparison afforded by lot 6, and we find that not only do lot 6 eat less of clover rowen and straw combined than lot 8 do of good hay, but on this lessened consumption they actually gain more and give to straw an actual value much greater than that of hay, as will be seen by the table. This enhanced value of the foods in combination may be ascribed to either the clover rowen or the straw. It properly belongs to both, for the value of both foods is increased by the mixture. The lack of albuminoids in the straw was supplied by the clover rowen, and its carbohydrates made available; or it is probably true that the excess of carbo-hydrates in the straw rendered available the albuminoids of the rowen. My experience teaches me that a great saving can be made by the combination of these foods in feeding, and that, as the table indicates, a pound of straw can be made nearly if not quite as valuable as good hay. In fact, in the combination given, the straw gives a better result than good hay. In the case of lots 3 and 6, a very much better result is afforded. The swale hay also in lot 1 gives nearly as good result in combination with cotton seed meal as good hay alone Adding to the swale hay $7.56 worth of the meal, and 3,496 pounds become of nearly equal value with 3,536 pounds of good hay, for growth. The 18 pounds difference in growth has now a value of 72 cents. Subtracting the value of the cotton seed meal, plus the value of the excess growth of the steers fed on good hay over the growth of those fed on poor hay, and we find the value of good hay that 2,496 pounds of swale hay has taken the place of. In this case it would be $12.73, or about 51 cents per 100 pounds of swale hay; and, as such, the good hay was rated at $12 per ton; this gives the swale hay, in round numbers, a comparative value of 86 per cent of that of good hay. Such hay as I fed is not usually rated at more than from two-fifths to one-half value of good hay. It

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was largely made up of the round grass abounding in our poorer meadows, that farmers so much dislike. In every case the combination of concentrated food with straw or swale hay raised the value of these poor foods. In repeated experiments I have found clover hay, or clover rowen, fed with straw to give as good results as good hay alone. Clover hay contains an excess of flesh-formers, and is thus a complementary food to straw, and when fed together the two foods become worth more than either alone, and as much as good hay. With a low amount of carbo-hydrates, clover, when fed alone, has disappointed farmers, and hence many in Vermont have said to me that they do not grow it because not worth much to feed; that they would as soon have oat straw. When intelligently fed I regard clover as one of our most valuable foods, and worth, in mixed farming, decidedly more than good hay.

FERTILIZERS AND CHEAP BEEF.

I have spoken of the use of rich food for cheap fertilizers. In the use of meat, blood, and at present of fish, I am using rich fertilizers for cheap beef, with what success the table shows. The nitrogen in these materials exists in the form of albuminoids, and is available as cattle food. Inasmuch as nitrogen is found in these materials as cheaply as in other fertilizers, and inasmuch as but a small fraction of a food given, goes to growth, being mainly voided by animals, why are not these materials fed an exceeding cheap source of plant food? I calculate that in feeding blood I got, or saved, the purchase price, when mixed with straw, and had $30 to $35 worth of the blood, per ton fed, in manure voided. Thousands of tons of these materials are annually used in New England, and the purchasers believe, at a profit. How much more profitably could they be used if first made to double the value of straw, then answer as a food direct, and still mainly go to the farm as a fertilizer. The feeding experiments of this winter in general, are corroborative of those of the past three winters. In view of these facts, and fuller facts from German sources, can there be any doubt of the very great economy of food combinations, based upon the character of food given? If not then all will agree that a very wide departure is called for from our present method of feeding; and that such a departure may have much to do in ushering in the period of farm prosperity so earnestly desired and needed.

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COST OF ANIMAL PRODUCTS.

So much, in the system of farming proposed, is made to depend upon successful feeding, and there is so much skepticism regarding the profits of feeding, that I go seemingly out of my designed course to review the probable cost of feeding, or rather of growing, animal products. Our ability to produce beef and pork is most questioned, that is, at market rates; hence I shall endeavor to throw some light upon the matter, and first with regard to pork production: If I can show that pork can be produced at market rates I have practically settled our ability to plow broad areas, and to farm profitably, for then we are placed in command of fertilizers limited only by our credit and ambition. I fed pigs for three summers, in periods each covering about six months. Average gain per 100 pounds middlings, to grow a 200 pound pig, 28.4 pounds. Average gain for 100 pounds western corn meal, 26.1 pound. Have you seen a time when 28.4 pounds live pig would not pay for 100 pounds middlings? Have you seen the time when 26.1 pounds live pig would not pay for 100 pounds western meal? I have seen many times when the pig would more than do it, yet the middlings are worth after feeding, over one-half of ordinary cost for manure.

COST OF BEEF.

From a great many weighing experiments I can tell, at least approximately, the amount of food consumed by animals of various ages and weights. From these figures I can tell approximately the cost of growing a steer to 1,500 pounds. In many cases I know exactly the cost of a pound of growth. For instance, the cost of feeding a pair of calves for 87 winter days, was $10.73. They gained 355 pounds. Cost of pound of growth was 3.02 cents, while the calves were fat. Common calves then sold for 4 cents per pound. Without dwelling I may say that I can offer abundant proof that calves can be fed to 500 or 600 pounds at a profit, and I assume more pounds can be thus grown. But supposing we could grow them no further at a profit, we may at least stop there with perfect certainty of success. I raised four grade Durham steer calves, dropped in the fall, and as I fed them for various purposes, weighed rations at intervals during the time they were kept, I know very closely indeed, to their actual cost. In pasturing, (hired) and winter feed they had cost, when weighing 1000 pounds each, an average of $33.50, and were then, fall of 1875, readily saleable at that price. Given a grade Durham steer calf, starting September 1st: At

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the end of 30 days he should be weaned off to skim milk, eating to that time 224 quarts of new milk at 2 cents per quart, and 30 quarts skim milk at .4 cent per quart, cost $4.59 to then weigh 150 pounds. From October 1st, to 10th of May, he will want 8 quarts skim milk daily, 2 1-2 pounds mixed grains, oats and peas grown and ground together, and fish meal, oil cake or middlings, with a little corn meal and what fine hay will be eaten. With skim milk at .4 cent per quart, mixed grain 4 1-4 cents per pound, and hay at $10 per ton, 7 pounds per day being consumed, we have a cost for 222 days of $21.81, and gaining at rates I have made, 2 1-4 pounds daily, would weigh 649 pounds. I may remark that if fish meal or oil-cake were given in the mixture, the gain would be low, apparently, but in that case I should consider the very high manurial value of either food would warrant a direct charge of part of the purchase price to the manure heap. Pasturing for 6 months $3.00, and 250 pounds of grain, given in early and late half of pasture period, $3.12, or total of $6.12; gain, 360 pounds; weight, 1009 pounds. Second winter of 6 months, 10 pounds straw or corn fodder, $5 per ton; 12 pounds clover hay, $10 per ton; and 5 pounds cotton-seed and corn meal per day; cost $26.55; gain at 1 2-3 pounds per day, 300 pounds, or total weight of 1309 pounds. Second summer in pasture to August 25th, $4, and 200 pounds of grain in May; last of July and August, $2.50, or total for second summer of $6.50. Gain for 100 days, 200 pounds, or total weight of 1500 pounds; fat enough to dress 1000 pounds, and good enough for the English market, and sure to sell above the cost. I do not claim, however, that beef raising east is profitable as an independent operation. I do claim that we can sell our produce at home; that we can buy grains and sell our domestic animals at full market rates, and that is enough to insure success for our agriculture, in broadened culture. It is as I have elsewhere stated, "early beef, cheap beef; cheap beef, cheap manure; cheap manure, cheap crops."

CHEMICAL MANURES.

I have said that farm animals are the cheapest source of manure, and while undoubtedly the farm may be made highly productive by the purchase of foods and feeding of stock, yet it will take too much of the factor time. It is railroad and telegraph times, and we want railroad and telegraph farming. We must not be the only industry that coach it. "The farmer does not run into the mouth of the sleeping lion." It is only the active and vigorous farmer, that uses

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all the factors at his command, that is to achieve full success. We wish to have the "new departure" in full sail within five years, and in order to fertilize each acre of the many better than each acre of the few were before we shall find it to advantage to use purchased manures or fertilizers to a large extent. Most of you say, Never, and that the advice to go in heavy is reckless and condemns the whole change you propose. Gentlemen, I wish it distinctly understood I recommend only what I am doing to advantage and, furthermore, that I would explicitly advise those who are not ready to put intelligence into the purchase and skill into the use of them to let them alone. The purchase and use of chemicals I will refer to further on. It is a popular belief that chemical fertilizers are stimulants, that make a temporary showing at the expense of the soil. Chemical manures are plant-food capable of growing plants and maturing seeds without the assistance of yard manure or soil materials. In pure water fine plants have been grown repeatedly by the simple addition of the chemical materials that compose a plant. The same has been done with sand from which all organic matter had been driven off by fire. If one plant can be so grown a million may, for there is no magic about the matter; nature cannot cheat. The plant was fed. Granting, what cannot be doubted, that inorganic elements never organized into plant-life may be organized into plant-life as freely as though they had been so organized, what we wish to know is what will be the result of the use of chemicals in field practice when used alone for a series of years. Thanks to Lawes, Ville, Nichols and others, we know. Lawes has had chemicals alone for grass, wheat, barley, oats, turnips, and other crops for from 30 to 40 years on ground continuously kept to the same crop. At the same time he has the same crop on contiguous ground without manure of any kind and with manure; in the case of wheat, 14 tons of good yard manure yearly applied. Time will not admit of a review of his experiments. Suffice to say that they are, as you will judge, very full and accurate and return for the chemicals crops fully up to the yard manure, giving, as an illustration, for wheat an average of, in round numbers, 36 bushels annually; for manure, the same; with no manure, 16 bushels. Prof. Ville's results for a long term of years have given full as marked returns. Dr. Nichols' results, in bringing up a worn-out farm successfully with chemicals, you have probably seen accounts of. I have 56 plats, variously fertilized, laid out permanently. The difference in the results between those in no wise fertilized and those treated with chemicals is as marked as the distinction in color between black and white horses. Last year a moderate use of chem-

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icals gave me 69 bushels of corn and 5480 pounds stover; 28½ tons of yard manure gave me 64½ bushels of corn and 4940 pounds stover. A volume, not of guess-work but of experimental proof, might be given of the efficacy of chemicals as plant-food. So well demonstrated is the proof of the success of chemicals as plant-food that it ought not now to need any argument. It is a settled question.

ARE THEY PROFITABLE?

Without doubt, if bought and used right. The following figures in part will explain what I mean: Prof. S. W. Johnson of the Connecticut experimental station found a fertilizer selling for $32 per ton worth but 99 cents; another for $35, worth $23.47; another for $45, worth $31.96. On the other hand, one that cost $30 was worth $41.06; another for $20 that was worth $36.96. This is but an illustration of a not uncommon fact. The How to buy includes the What to buy, and both call for a little elementary knowledge of plant-growth, or rather, nutrition. I should grievously mistake if, out of a spirit of flattery, I assumed that all or most farmers had the desired information on this point. You will pardon me for saying, buy an elementary work on plant nutrition, and thus make a pleasant study worth months of hard work. To cover my design of showing how to use chemicals profitably I will need to state briefly a few facts. While more are found in, yet no plant can perfect itself without 12 to 14 chemical materials enter into its growth. The lack of either one is destructive to the hopes of a plant or a crop. We need not enumerate the materials. A long line of reseach has made it more than probable that the soil and air will have abundance of all but three of these materials, for ages to come, that plants want. These three are nitrogen, phosphoric acid and potash. For the exact man, who will criticise this statement, I must qualify what I meant for simply a practical statement. I know that lime, sulphuric acid and magnesia are not over abundant and the two former easily washed from the soil; yet I had in view the fact that the first two materials come in all fertilizers as sold, or in the purchase of the three needed materials these come without charge to the farmers. The What to buy includes not more than these three materials, nitrogen, phosphoric acid and potash. Of nitrogen it may be said that natural sources, rain, atmosphere and the soil furnish a considerable annual supply; and again, that many crops have a strong individual capacity to gather this nitrogen. Clover will get its full supply thus, and most leguminous plants, peas, beans, etc., nearly all of it. Corn, by Prof. Atwater's,

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mine and others' experiments, is shown pretty conclusively to have power to gather one-half to two-thirds or even more, varying with the season, of its nitrogen supply from natural sources. This fact will take off $8 to $10 from a formula cost, based on composition of corn, of fertilizing an acre for it. I am convinced that in our dry climate, where but little water leaches through the soil from fertilizing time to harvest, that we need not use costly nitrogen nearly so freely as is done in England. If so, this is a great advantage to us in the use of chemicals. I would not apply to any of our crops what is known as full formula amounts of nitrogen. That is, I would not use it in the same proportion relative to potash and phosphoric acid as the analysis of a plant would indicate. Of the two minerals the only source is the soil so far as nature directly aids your crops. Weathering furnishes a variable supply annually, but not enough. Superphosphates, in the past, have been compounded on the assumption that soils furnish enough of potash—a grievous mistake that has had much to do with the bad reputation of fertilizers. But some soils do contain a plenty for the immediate future, at least. Other soils have a plenty of phosphoric acid, though not so common. I can give an illustration: On my own farm, I find by experiment, that potash is not much, if any, in need, and that the crop rises and falls with the phosphoric acid supply. On the college farm I find that it is entirely useless to expect a crop without adding potash, and that phosphoric acid makes but little impression. Last year I got 63 bushels of corn from $3 worth of potash salts—more than twice as much as the unmanured plats—while the phosphoric acid made an increase of only 4 bushels. To know what to buy, you must know your soil. To know your soil, experiment. To know your soil, put sulphate of ammonia (giving nitrogen), bone-black (giving phosphoric acid), and muriate of potash (for potash), to one plat, all three. To a second plat, the bone-black and muriate of potash. The difference between the yield of the two plats will indicate the loss of crop from the withdrawal of the nitrogen supply. On a third plat use bone-black alone. The difference between the yield of plats two and three will indicate the influence that potash has in your soil on plant-growth. On a fourth plat use no manure, and on a fifth, yard manure. These will give you standards to estimate the value of chemicals by. The results for a year of two may not be taken as absolute standards for practice in fertilization, but they will certainly be valuable hints to modify your practice.

I think none of my neighbors use fertilizers. They have tried them and denounce them as worthless. They bought phosphates.

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The soil is alluvial and, like most alluvial soil, needs potash. Now, I find by three years' experiments that the soil wants potash, and that its use is exceedingly profitable, and I consider the knowledge worth very much to the farm. My practice has been modified in several things for the better by it, thus far. Search out the needs of your soil and buy what you find wanting; nothing more until it is needed. If you have a weak link in a chain you have that link strengthened, not the whole chain.

In buying, buy the chemicals. Club together and buy by the carload. Buy of parties that have a good standing at the experiment stations. Buy everything guaranteed. Get everybody's circular, and buy with a full knowledge of market rates. We buy fertilizers now without knowing what we want, what we have got, or whether it is high or low in price.

I would have you buy the chemicals, 1st, because less subject to fraud; 2d, because the plant-food is in better form and more efficacious; 3d, because more concentrated, thus saving freight; 4th, because they can be bought cheaper; and 5th, because you can thus buy what your soil wants. I think I have been bettered 25 per cent by thus buying, an amount that would make the difference between profit and loss. I use sul. ammonia, dissolved bone-black and muriate of potash.

HOW TO USE.

The world's experience and my own—about which I know most and therefore allude to it—I think is pretty conclusive in favor of using the chemicals and yard manure in conjunction. They never should be divorced in practice and cannot be to the best advantage. Either of them used alone will give neither so much crop or profit as the two together. The manure, in our expansive system of farming, should be spread over twice or thrice the ground as formerly, and the diminished amount more than made up, for the year, by chemicals, aiming for a larger crop than before. It should be thoroughly spread, evenly as wheat, to be of full use. The fibres of your crops must find its plant-food, all through the soil, evenly distributed. Any other distribution gives an abnormal development of roots, working in various ways to the disadvantage of the plant. This implies, of course, thorough tillage. I should prefer to have a small fraction of the fertilizers in the drill, but only on condition that it should be spread out, not by any means in a body. In addition to four cords of manure per acre I use for corn 60 to 80 pounds sul. ammonia, 150 pounds of muriate of potash, and 100 to

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150 pounds dissolved bone-black. On upland soil, while ascertaining by experiment his needs of soil, I should advise a farmer to use 80 pounds of the potash and 200 to 300 pounds of the bone-black besides the ammonia. In regard to profit, from well-kept figures I can assure you that I have received as high as $10 increase of crop for every $1 used in fertilizers. This may be regarded as owing to a special lack of potash which is so cheaply added. Where I have added all three of the materials I have found a profit in their use, as I shall have occasion to show you before I close my remarks.

ROTATION OF CROPS.

By a judicious system of rotation of crops, I am convinced that the products of Vermont could be materially increased without any other influence. Our present method of cropping is founded upon convenience rather than from any recognized rule or law. The importance of systematic rotation of farm crops on the continent and in England is well known. It springs from a popular recognition of what is undoubtedly a fact, that in a term of years a very much larger amount of food can be taken from an acre of ground under a well defined and intelligent rotation of crops than under a "rule of thumb" rotation, or the continuous growth of one product, as we come so near doing here with grass. One fault of our rotation or want of rotation is the small amount of

TILLAGE.

I think it was that old Roman, Cato, who made among three essential things in cultivation, "Good tillage" of first importance, "Tillage in the ordinary way" second, and manuring, third. Roman agricultural literature abounds in terse expressions indicative of high appreciation of the efficacy of tillage. Cato is not alone in ascribing to tillage a greater importance than manuring. Jethro Tull has become famous for his advocacy of the efficiency of tillage and his remarkable success in practice of his view. After him the Rev. S. Smith, of England, achieved renown in the same direction. Their system can have no general success. Their zeal and success should inspire us to carry on more thorough tillage. Tillage is manuring, and undoubtedly the cheapest source of manure or its equivalent, but it is unfortunately not a sufficient source. Joseph Harris claims that an extra plowing gave him, per acre, $15 worth of beets. Some very rich soils contain as much nitrogen and even more, per ton, than a ton of good yard manure. But this plant-food, for the most part,

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is an insoluble compound. Thorough tillage gives freer access to those atmospheric agencies that have had so much to do in forming soil from rock. Oxygen and carbonic acid gases are your helpers, constantly making soluble potash and phosphoric acid from insoluble compounds. Slow, but with speed measured by your skill or industry in opening an opportunity. Our soils are said to be as rich, chemically, as those of the west; the trouble is in the mechanical conditions, of fineness of ours in degree. The relation of temperature and moisture to the soil are both affected by tillage. Time will forbid dwelling. I wish to make the point that the extensive cultivation proposed in this talk will call for a greatly increased amount of tillage, and on its part tillage will help feed the crop.

RULES OF ROTATION.

Prof. Tanner in his "First Principles of Agriculture" lays down several guiding principles in rotation of crops: 1st. "Plants that require the same kind of food should be kept as far apart as possible." In illustration of the wisdom of this rule and of rotation of crops we will suppose the ground treated to 20 tons of average yard manure, containing 260 pounds potash and 130 pounds phosphoric acid. If potatoes were grown at the rate of 200 bushels per acre, then the first crop would require 68 pounds potash and 22 pounds phosphoric acid. Over a quarter part of the potash would be used, and only one-sixth of the phosphoric acid. It is readily seen that the potash would be exhausted first if potatoes were continuously grown on the same piece of ground.

The rules of rotation would call for a following crop with a comparative low demand for potash; or as we are to farm with chemicals, potash might be added, and if desirable follow potatoes with the same crop, or a potash feeding crop. I do not mean to say what is a very common mistake to suppose, that the material found in the crop in the largest quantity is the one which if added to a soil will assist that crop most. It rather seems that the opposite rule prevails under ordinary conditions, yet it would not by any means follow that it will at all answer to pursue a course of cropping that calls annually for an undue amount of any one material. It is claimed that modern science by feeding each crop what it wants of chemicals does away with the need of scientific rotation of crops. There can be no doubt that chemicals rightly used modify the necessity of rigid adherence to rules; still there is so much yet to learn of the distinct individual characteristics of each plant in growth that past

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experience cannot be ignored safely. It is well known that there is but little land that will bear clover continuously. Once in 5 to 7 years is as often as it can be generally introduced to advantage. Dr. Lauz in some interesting experiments found that he could not keep clover on the same ground continuously by any method of surface or subsoil manuring. Where the same gentleman used 14 tons of yard manure every year for 30 years, he received no more than 14 per cent of the elements applied in manure in return crops. Rotation of crops in the present condition of our knowledge is yet a necessity and must enter into our change of system, especially as we are to use yard manure.

2d. Prof. Tanner says: "Plants of the same habit of growth and general character should not fol ow each other." The great diversity of plants in their habits of growing and feeding are not understood or appreciated by farmers generally. The roots of some plants feed near the surface, like barley and some of the grasses, (barley is a grass); others like wheat feed more in a deeper layer of soil, while clover feeds mainly, or largely, from the subsoil. Manure washes from the surface soil into the subsoil. Suppose a farmer grows wholly shallow rooted plants he will fail to get all of his applied manure possible to obtain, but will also fail in not leaching his whole soil area available in getting much that nature is constantly offering. From its deep roots and broad leaves clover gains much of its growth where many crops would gather but little. It is our great renovating crop, leaving more fertility in the surface soil by its decay of roots than it has taken from it. Hence when followed by barley or wheat it proves actually an enriching crop. It is customary in a good rotation to grow one of these crops after clover.

Other distinctions in plant-growth enforce the necessity of rotation. Narrow leaved plants follow broad leaved plants; the latter gather more from the atmosphere than the former, and storing it up in their roots furnish in their decay food for the following narrow leaved plants. Then, again, many plants, like the root crops, carry green leaves down to freezing, in fact, the roots make most of its growth in the latter half of the season, after organic matter of the soil by moisture and heat has yielded its nitrogen by nitrification, in its best and available form for plants, what by its early and short time of growth before these processes have come into full play, requires a heavier artificial supply of nitrogen. Again, plants have a varying proportion of roots to top. The proportion of the roots to tops of some of our field plants are very light, while in others, like clover, it is very heavy, amounting to fully as much as the top.

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Prof. Voelker in one of his investigations found 3 1-2 tons of clover roots and stubble in the first 6 inches of the soil, and as they are rich in nitrogen they contained enough for 37 1-2 bushels of wheat. In another case from a good crop of clover of 3 1-4 tons, the stubble and entire roots contained 180 pounds nitrogen, or as much as is found in 900 pounds sul. ammonia, costing over $40.00, most of which is gathered from the subsoil where it has been washed by rains, and from the air. I am surprised to meet many good farmers and substantially whole districts in Vermont where this crop has not a good reputation, and is not grown.

In view of all the facts stated, it is apparent that an intelligent rotation of crops will assist us much. What that system of rotation must be will need to be worked out in the light of markets and special circumstances. It need not, where chemicals are freely used, be as rigid as European systems.

MACHINERY ON THE FARM.

Grant me, if you will, that my positions are sound thus far and that intensive farming is the only farming that has hope in it for an old or worn country battling against competition from virgin soil. Yet I would give it all up in despair if restricted to the mechanism now in common use on our farm. It is an age of metal against muscle, and the first vastly cheaper and more effective. We all put our faith in New England industry, but it must be rightly applied. It is inviting disaster to measure our arms on our rough soil against the machinery of the west on fertile plains. If the contest is in any way equalized it must be "steel against steel." Their transportation costs will pay our fertilizer bill, and thus make it a fair profit. I have farmed on hill and in valley, and anticipate objection in the unqualified assertion that there are but few farms in New England worth farming where machinery may not be used to advantage. Small rocks may annoy but not thwart a full line of farm machinery. Fast rock, or the farmer, must go. What with rock lifters—if it does cost $5, $15, $30 or even $50 per acre (always less than it looks),—no well cleared field in the east that in a skilled farmer's hands, will not pay interest on $100 per acre. No fields, or acre, that will cost the larger sums named to clear that will pay anything unless cleared. The obstacles, if lions, "are painted fiercer than they are." Large farms for profit—small farms successful only through the co-operative use of machinery. I do not call any farming successful that puts wooden shoes on to the manager like a

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French peasant with his 10 acres and hand tools. We want no such success in the east, nor will our farmers accept it. Machine farming is not slip shod farming, but cheap, thorough tillage farming. Good machinery well used means finer soils, more moisture and larger crops than by hand methods. A well fitted field means fine, deep tilth and turfless surface. The little seed that drops into a lumpy soil covered with turf and lumps of manure, as it starts its tiny microscopic (almost) roots, plunges its starving little rootlets, just opening up to battle for existence, into cavities here, to wither with drouth and stint or starve, and against resisting lumps there, or again to be surfeited and destroyed in raw lumps of manure. Perchance it may have fallen on to one of the many hundreds of upturned turfs or lumps to wither if it sprouts. A fine soil with manure thoroughly intermingled must call out the baby rootlets in all directions, and give a normal development to the roots if a strong plant is to follow. The old square-toothed harrow won't do it right. Its days are numbered. So all along the line of farm work it is not only cheap work we want and get, but good work we must have. But work must be done cheap. A two-rowed corn-planter will do the work of 10 men and better. I would not allow my land planted by hand for nothing. The "Thomas Smoothing Harrow" will do the hoeing of 20 men, and better. In drouth I keep it running through the corn every few days, and thus by breaking up the capillary tubes I mulch the soil and prevent evaporation. The "Randall Harrow" does more and far better work than the old harrows. The clod-crusher fines the soil. The sulky plows performs more and cheaper work, while the driver leisurely rides. Our genteel driver in fresh spirits, as he rides his fertilizer distributer,* doing better work than by hand, covering 10 to 12 acres per day with ashes, or 15 of fertilizers or grain, revolves in his mind with pride the increasing ease and dignity of farming. And so we might go on through a list of machines for the farm, covering the potato planter, digger, and lesser and larger tools that certainly must accompany a large business. The tools will pay when the business is large. The relation of tools to our farming may be seen in the statement that one man alone can now easily carry 25 to 30 acres of corn to harvesting. It may seem a little poetic to intimate that farming is likely to develop into a fine art and a learned profession. The adjectives may be a little broad, but good farming is to take a high position among eastern industries. I am asked where

*This spring of 1880 I sowed of ashes, grain and fertilizers, fully 90 acres, paying for the machine in one season.

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the capital is to come from to do all you outline. It is asserted that our farmers have limited funds—true. The question of capital is the least difficult one in the problem. The capital is in the determination to do. Leave the rest to our Yankee farmer. Besides, the scheme intends to pay as you go, nearly, requiring but little extra money. I have increased the plowings at our college farm from 13 to 45 acres, each of which is well fertilized, and doubled the personal property of the farm out of the net earnings of the farm and expect next year, 1881, to run it up to 65 acres without aid.

ILLUSTRATION OF PROPOSITIONS.

As an illustration of the efficacy of fertilizers, machinery and superior profits of tilled lands, I give the result of 16 acres of ground to corn last season, all in one piece. I may add that before I made the change in system pursued, I could manure only 8 acres of ground, 28 ox-loads per acre, and averaged probably 50 bushels per acre. A small bill is included for hoeing. I think that hand hoeing is unnecessary for corn or potatoes—indeed, I had no hand hoe in my potato field. I should not now use so much yard manure per acre and thus cover more ground. The ground is a heavy clay needing drainage, a few acres of which have never been planted to corn. At least 1-2 of the field is considered as poor corn ground. The wetter portion of the field was plowed in beds, thus obtaining surface drainage.

CORN FIELD.	DR.
To 2-5 cost for man, horses and oxen at $4 50 per day for 13 days	$23 40
To 3 harrowings, Randall harrow, man, pair horses and harrow at $2 50	15 00
To man, pair horses and smoothing harrow 1 day	2 50
To man and horse 1 1-2 days planting	3 37
To man and pair horses 1 1-4 days rolling corn (or hoeing)	3 75
To man and horse 2 harrowings corn, 3 days	5 42
To man and horse twice cultivating and once hilling, 71 hours	13 26
To man 1 day planting over	1 25
To 3 3-4 bushels seed corn	3 75
To 12 1-4 days' work last of July weeding	15 31
To 40 days' work stooking	50 00
To 30 days drawing in and mowing butts	30 00
To 8 days' ox work drawing in	5 00
To labor for husking 2,390 bushels of 40 pounds to basket at 4 cents	95 60
To 1 acre to 28 loads of manure, of 1 ton drawn and spread at $1 60, 1-3 of	14 93
To 12 acres to 14 loads of manure, of 1 ton drawn and spread at 1-3 of cost	89 60
To 2-5 of 150 bushels ashes spread, 3 acres	18 00
To 100 pounds sul. ammonia, 100 pounds dissolved boneblack 40 pounds muriate of potash and 60 pounds fine ground bone $3 94, per acre, 13 acres	116 22
To 3 acres of chemicals as above except potash omitted $8 06	24 18
To mixing and applying fertilizer, 9 days	11 25
Total	$541 79

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CORN FIELD.	CR.
By 16 acres fodder, 56 tons at $6	$336 00
By 1,125 bushels shelled corn at 75 cents	843 75
Valuation	$1,179 75
Balance for use of land	$637 96

EXPLANATIONS.

I charge 2-5 cost of breaking to corn only, holding that a part of the costly breaking of the sod properly belongs to crops in the following rotation, they getting much benefit from the thorough tillage given corn, each after plowing being cheap. Previous to drawing corn I charge man $1.25 per day. The farm being practically in the heart of a village our labor costs more than on most farms. Horses and oxen are a part of the farm capital and should never be considered as costing more than interest on cost—cost of keeping and depreciation. I have included one horse for 62 cents per day.

The planter used was a two-rowed planter, made in this state by Hon. Moses Humphrey. The harrow used was the Thomas smoothing harrow constructed for the purpose. I should have used it 3 times and the cultivator but once. The drag was a home-made one generally used for fining lumps. It was used just as the corn was breaking ground and before the harrow was used. I consider it essential to use the roller on our soil to pack it a little for the coming harrow. It also gives the ground a most excellent hoeing. The free use of these implements named, including cultivator, kept the ground mulched during the drouth, and thus prevented evaporation. The corn was planted in hills 22 inches apart and 3 kernels in a hill, rows 3 1-2 feet apart. I used the Ross implements of cultivation and hilling.

Two-thirds of the fertilizer was spread broadcast with much care to get it even. The balance was strewn in a band the entire length of the drill after planting and before dragging. It is to be noticed that 3 acres were to ashes and chemicals alone.

Gentlemen, in my long and somewhat confident remarks I fear I may have seemed somewhat dogmatic. I assure you I came to the discussion of this question with you with no such feeling. The field of agriculture is broad, embracing so many sciences, ramifying in so many directions where there is as yet total darkness and so little really settled that the prospect of ever knowing much about it sometimes seems almost hopeless. Yet we have made some advance, and in that direction I would move with prudent confidence. I can see striking evidences of a change in our agriculture rapidly going

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on. The drift of agriculture is already in the directions I have named, so that I do not arrogate to myself any monopoly of perception of the wants of our farmers.

Without any desire to flatter, I may remark the great pleasure that I have had in meeting the farmers of Vermont, everywhere turning out good audiences of fine looking, robust, intelligent farmers. Vermont holds a rare body of farmers, and may she for her sake and that of the individual, long continue to, for I believe a more prosperous future awaits you as farmers here than elsewhere. In every age a mountainous people have been celebrated for their robust attachment to their boyhood homes. Even the restless, change-loving Yankee reluctantly parts with the mountain scenery that has nursed an early and manly ambition, because he believes that home does not promise. I am pleased to believe that the same hills that have made you strong and brave will yet yield to your courage and skill compensation that shall fill your homes with a plenty and refinement excelled by no other farm people of this broad country.

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CURIOSITIES OF PLANT GROWTH

AND THE WORTH OF SUCH OBSERVATIONS TO THE FARMER.

By Dr. HIRAM A. CUTTING, State Geologist.

It has been ascertained by a multitude of observations, that the plants which we meet in every section and which become so familiar to every person, while they are in most instances rooted in the soil, derive 95 per cent, or more, of their actual weight from the atmosphere. While the food derived by the plant from this atmosphere is beyond our control, the small portion of its food derived from the soil is of very great importance, as a proper condition of the soil is always necessary to enable the plants which are of the greatest value to man to take such an amount of food from the atmosphere as to bring them to a perfect maturity. To thus adapt the soil, so as to enable the plant to perfect itself and thus give a more vigorous offspring, is the science of agriculture. To perfect ourselves in that science we must be observers of nature, and then turn our own observations, or the observations made by others to account. We all know that plants grow, and that vegetable growth is the development of the several parts of a plant, according to a definite, pre-determined plan, as regards general form, size and other characteristics of the species under consideration. We further know, that that condition is the result of an active, inherent force called life. When we by aid of high magnifying power seek that force, or that principle of life, to our view it is presented to us as a cell, and when we magnify further we find that cell of growth contains a substance which is called protoplasm, of which I shall speak by-and-by.

Thus we find that whether animal or vegetable, the first origin of life is a simple cell. This is in fact fully shown by the microscope, yet when Dr. Wm. Harvey of England first announced this fact in 1650, and also that blood circulated in the arterial system of all the animal creation, instead of air, which was previously supposed to permeate our system as it does the bodies of birds, it was viewed with astonishment by all, and doubted by many. From this beginning the true principles of circulation have been shown to originate

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in the germ, or cell, whether animal or vegetable, and on that circulation the growth depends. Harvey commenced his observations on embryology by observing the development of the embryo in eggs, which he kept for the purpose under a setting hen in the chamber of a friend. For more than 200 years this study has received the attention of scientific men, some devotees observing embryol development in many thousand cases, yet all have failed in the main points, though much has been learned. If the inquiry into the origin of life is so baffled concerning the changes which occur in the almost transparent material of an egg, out of which the varying organs and fluids of the complete animal are developed, can we expect success when we attempt the study of the reproduction, and growth of plants? The hardness and opacity of the seeds, the complex chemical constitution, and exceeding simplicity of its cellular tissue, within whose secret chambers the processes of vegetation are carried on, all conspire to discourage and bewilder the investigator.

Some seeds retain their vital energies but a few hours, as the seeds of the willow, while others retain that vitality for centuries, like the wild cherry, or even our cultivated wheat. If two ripe seeds from the catkin of a willow are taken, and one placed in suitable earth, and the other in a dry room, both change rapidly. In 12 hours the one in earth is ready to burst its integuments, and in 18 it is sending its roots downward according to the law of gravitation, but its plumule, or stalk, upwards, towards light and air, in opposition to the same law. Yet the difference is so slight in the willow, that after the stem of the tree is formed, it may be inverted, and its limbs nourish the roots, which send forth leaves. Then re-inverted with the same result, not only once each year, but once in from 4 to 6 weeks, the entire growing season. Of our other seed, in a few hours it has lost its vitality without much apparent change. If now placed in the earth it absorbs moisture as before, but only to hasten its decay, as from some unknown cause that germ known as life has departed.

Our growing willow increases in size until autumn. Its leaves then fall, but not from cold, but because a period of rest is needed, similar in some respects to the hibernation of animals. This annual cessation of growth is essential to the health of most species, yet in some, like the orange or lemon, it is not so apparent. From this requirement, more than any other, the failure to blossom arises in our hot-house plants, because that period of rest, either from cold in northern sections, or from drouth in tropical countries, is not given them. During that period of rest most trees contain less

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water, or sap, and seem to harden in all their tissues. But what is this growth of which we have spoken, and as we shall show in our most fragile plants, so considered, is capable of raising tons? Of course it is from the nourishment received in some way by the plant, and it requires only limited observation to decide that it must in the main be through the rootlets and annual leaves; as the animal takes food through its mouth, so does the plant through its little rootlets, some too small even to be seen by the naked eye. As the animal breathes so does the plant, in a manner peculiar to itself through its leaves, which have large numbers of stomata, or breathing pores, usually most numerous on the under side. The leaf of the lilac has none on the upper surface, but as many as one hundred and fifty thousand to every square inch of its under surface. These breathing pores are so constructed that when the atmosphere is dry they nearly close, and open wide when it is damp, but always remain shut except under the stimulus of light. Thus a tree in dry weather, by keeping these pores shut, retains the water otherwise evaporated from the sap through the leaf, and thus prevents drying up and cracking; but its growth is also checked, as it is through the leaf that the excess of water is disposed of, and the valuable plant food taken up as dissolved by the water, retained, and appropriated to cellular growth.

In regard to the size of these vegetable cells, it is difficult to obtain a correct conception, unless the reader is conversant with the use of the microscope. In every cubic inch of maple wood, for example, there are doubtless no less than one hundred millions of cells of the various tissues. The average diameter of plant cells is usually less than one four-hundredth of an inch, and even the ducts or continuous tubes are not usually much larger, and are often much smaller than this. Prof. Gray says, "that in these tubes, in basswood, which is one of our less compact woods, that sap must pass through 2,000 partitions in every inch of its ascent." In this way it must in an ordinary tree pass millions of such membranous walls in passing from the rootlet that takes it in to the topmost leaf by which the moisture may be exhaled. The vegetable kingdom was created for evident purpose, as on that depends not only all the food, but all the vital air, which is indispensable to animal life. Every growing plant is a machine, converting mineral matter into digestive substances, which may be eaten, and nourish various animals, and at the same time exhaling continually under the stimulus of sunlight, from its myriads of stomata, pure vapor of water and oxygen gas, indispensable to the life of all animals. Why do not ungrateful persons con-

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sider this wonderful work of the Creator? But this is not all, as the plant gives food to man, and an atmosphere on which his life depends, it takes substances deleterious to the animal from the atmosphere, appropriating them to its own use. The substance taken chiefly is carbonic acid gas; this is absorbed by the green parts of the plant through pores for the purpose, and nearly one-half of the weight of dry vegetable matter is thus obtained.

Vegetable growth, as derived from the two sources named, is an increase in size and weight, in consequence of the multiplication and enlargement of cells, and occurs chiefly in the vicinity of the cambium layer, so called, which in the growing season envelops every root, stem and branch between the wood and bark, and permeates between the two outside layers of every leaf. The mode of this cell development has been carefully studied by the aid of the microscope, and may best be observed in aquatic plants.

The vital fluid, corresponding somewhat to the blood of animals, and existing in every growing vegetable cell, is called protoplasm. This is usually thin, and sometimes nearly colorless, and encloses a minute globule, called a nucleus, which often contains other nuclei more minute. The contents of each cell show motion, usually circular, within its walls. The contents of adjoining cells frequently having motion in opposite direction. There are two general modes of growth. In simple plants, it is common for the protoplasm to gather itself in two portions within the parent cell, and develop a nucleus membrane for each. These young cells then grow, burst or absorb the membrane of the original cell, thus becoming independent. In all our higher plants a different process is observed. The protoplasm first begins to contract in the central portion, and thus divides or develops a new protoplasm, for the cell about to be formed. Each portion then grows, the new cell repeating the process. Thus the plant goes on increasing both above and below the ground.

In a growing plant the cells are first formed at the tip of the stem and subdivision there goes on during the period of growth; but it is believed that all vegetable material is primarily formed in the leaves, or green parts, of ordinary plants, and then passes, by circulation, to the point of growth. If so, it is of course transferred in liquid form, but just the process is as yet hidden from human eye. We, however, are led by reason, to admit that life as developed in the plant, is a molecular force, capable of exerting great power. Increase of wood cells may sometimes take place under great pressure, as in my native town I have visited, frequently, a large yellow birch that rests upon a big rock, sending its roots down to the soil for

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nourishment, and annually producing its regular growth; yet the whole tree, which must weigh at least four tons, is raised as regularly the thickness of the grain of new growth formed upon those roots, each year, which is about a quarter of an inch. Since my observations commenced upon it, the entire tree has thus been raised four inches. This in no way interferes with the statement of facts made by Prof. Asa Gray, and other eminent botanists, that two points in a vertical line on the trunk of a tree will not separate as the trunk enlarges, as no tree is raised by its growth more than half the diameter of the roots, and only thus, when a tree stands upon a solid foundation. When therefore, any writer asserts, as has often been, that carving or letters made by him years before, are high above his reach, it has no foundation in fact.

The following illustrations show this point more fully: At Walton Hall, in England, in 1863, was to be seen a filbert tree, the seed of which was planted in the central hole of a millstone in 1812. This tree had grown until it had completely filled the hole in the stone, and standing upon a rock beneath, its growth then raised the millstone full 2 inches from the ground. In Middlesex, Vt., there now stands an elm beside the highway, with a large rock beneath it, and a rock weighing some 30 pounds, (which was doubtless rolled against the tree when young) imbedded in the tree, and raised nearly four inches from the ground. Thus the growth of a tree raised not only its own weight but that of a foreign body by its annual growth. In Concord, Vt., a spruce tree growing near a large granite boulder, sent a root under it, and thus raised this boulder on the side next the tree, 4 inches, though it had no other rest upon that side than the root which grew between that and the rock beneath. The amount of stone raised by this root is not less than 5 tons. From the above examples it is clearly demonstrated that the power of vegetable growth can lift not only trees but the additional weight of large stones, whenever the roots cannot be depressed in the soil by reason of having a solid substance beneath them.

But we will now consider this power in smaller plants. It is a well known fact that beans, corn and other vegetables, will lift a considerable weight in coming up through the ground, providing they meet with such obstruction as a stone or lump of dried dirt. Mushrooms have great lifting power, and sometimes raise door steps and large flagging stones. Recently in Worcester, England, a gentleman noticing a large stone in his walk raised somewhat, sent for the police, thinking burglars had been at work. The stone was taken up

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and the rogues were discovered in the shape of three giant mushrooms, which had raised at least about 80 pounds.

But the expansive power of vegetable growth has been more fully illustrated by Prof. W. S. Clark of Amherst, Mass., who has grown a squash in harness, or in other words, when subjected to a pressure of over 4,000 pounds. This squash after obtaining its growth under immense pressure, (commencing its life under a pressure of 60 pounds, which was gradually increased to upwards of 4,000) weighed 47 pounds. This is not only proof positive of the great power of vegetable growth, but certainly shows a great capability of exertion under difficulties, which might be a comparative lesson even for man.

Another capability of vegetation, often overlooked, is the immense expansion of root.

With a few exceptions from the first development of the plant the roots tend downwards, seemingly in accordance with the laws of gravitation, until from their need of food, or otherwise from the compact nature of the soil, or from rocks, they expand in all directions. Their growth is in great part by lengthening, and very slowly in size. The point of growth in a root is not, as in a twig, at the very end, but a short distance from it, perhaps in our common cultivated plants about one-sixth of an inch. In transplanting trees this end is quite likely to be broken off, and if so the root broken never extends itself; hence may be seen the absolute necessity, (if you would have your trees thrive well), of transplanting with care, and as such growth continues in a direct line, unless some obstruction turns it one side, you can see the necessity of straightening out and thus directing the rootlets of the tree you transplant, as by so doing you will forward its growth, by one half, for the first five years, at least.

In a large tree and, in fact, with most plants, not all that branching portion beneath the ground are true roots; they are subdivisions of the stem to hold it erect, or in a solid position. The nourishment is in the main received from the rootlets that are no larger than knitting needles, and smaller.

It is an erroneous opinion with those who think that nourishment is only taken in at the end of the rootlet, for none is there taken, but it is taken all the way its entire length, unless it is old and covered with a bark quite like the part above grownd. The rootlets that assimilate food when examined by a microscope are seen covered with minute hairs, which are tubular elongations of the external root cells, and are all so many mouths to supply the plant with

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proper nourishment. They are in reality innumerable, or, in other words, beyond the power of the human mind to comprehend their number. Their length is also simply beyond computation.

The root of the elm has been dug out of the soil in its healthy state 40 feet below the surface. I have seen the roots of a maple tree which stood 65 feet from a grave, which was 5 1-2 feet deep, and where the burial had taken place 15 years before, not only enclose the coffin with hundreds of rootlets, but to completely fill it with a network of the fibrous rootlets no larger than ordinary threads. Of course all the remains the coffin formerly contained had been stolen away to make up the tree growth. Clover roots have frequently been washed out of a sandy soil on the banks of streams in New England from 4 to 9 feet in length. Parsnips have been dug out of alluvial soil in California, 14 feet long, and by Mr. Dixon of Riven Hall, England, 13 1-2 feet long. Of the two last named plants, the roots run perpendicular into the soil.

Many supposed cases of fossil wood, found 40 or 50 feet below the surface, are shown by the microscope to be roots of trees vegetating on the surface. Such supposed fossils were a few years ago found 35 feet beneath the surface at Burlington, Vt., but by recent examination I find these fossils, so called, to be elm roots. But this seemingly incredible length of root in this section is not only doubled, but even twice as long in warmer countries. In India, roots of plants and trees are frequently dug up for economical purposes, to the depth of 60 or 70 feet, and in South America, even deeper, without in either case reaching the end of the roots. Elm roots have been known in Randolph, Vt., to obstruct an aqueduct for conveying water, 370 feet from the tree, and it has recently been stated in an English agricultural paper, that a tile drain was obstructed by the roots of an elm 450 feet from the trunk of the tree.

The rootlets of Indian corn may be found any season on good soil from 4 to 10 feet from the plant, and in my cornfield this year, with hills 4 feet apart each way, when you look 1 inch below the surface you cannot find a cubic inch in the field which is not permeated with the rootlets for at least 10 inches in depth. This demonstrates fully the folly of using phosphate or any other fertilizer in the hill, for you cannot hide it in your field where the rootlets will not find it; and how much better to have your plants find a regular supply for the season, and consequently mature the fruit, than to be stimulated into a rapid growth the first part of the season to be blighted for want of nourishment when maturing fruit. If I put but 100 pounds of phosphate or other concentrated manure upon an

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acre, I should sow it broadcast, as by so doing your plants find a regular supply for the season, and not an excessive one for a short time, which, when exhausted, leaves the plant in a worse condition than it would have been if it had never had it. I have spoken of corn, but other plants have similar rootlets and are subject to the same laws; as shown by Prof. Clark of Amherst, the roots of the squash have a length almost incredible, as one grown in a hot house box by him had an aggregate length of over 2,000 feet.

It is well understood by all that the water and plant food taken up by the rootlets circulates as sap through the tree and as in the animal a life principle is necessary for that circulation, yet just how it is accomplished is a mystery. I shall lay down no regular rule for nature to work by; as I believe that the circulation of sap in all plants may not be produced in the same manner; I shall speak of observations made by myself, and others, illustrative of facts in such circulation in plants and trees most familiar to all. In 1720 Rev. Stephen Hales, of England, observing a grape vine bleeding abundantly, and fearing injury endeavored to stop the flow by tying a piece of bladder over it. This was forcibly distended, and he attached a gauge and by a series of experiments determined that the pressure from the end of a grape vine would equal the pressure of a column of water 43 feet high. Almost all writers on plant growth since that time have said something about this experiment, but a large majority have spoken of this vine as an exception to the pressure exerted generally in sap circulation in different plants.

Led by the great flow of maple sap in 1853 to investigate specially the sugar maple, I found that by screwing a stop cock, with a pipe attached, into a tree that the sap would rise in the tube to the top of the highest branch on the tree subjected to the experiment, and sometimes a few inches higher. Finding also that the proportionate amount of sap discharged was according to the height above the tapping, as though the sap stood on pressure in the tree, I was led to examine farther into the circulation and found, after freezing, a microscopic change in the sap wood, showing rupture of the membranous partitions and enlargement of the ducts themselves. This is doubtless the result of freezing and as the outside of the tree freezes first there is a pressure also exerted by the expansion of the sap tending to force it in towards the centre of the tree, and a greater amount of sap is found after a severe freeze in the heart wood than at any other time. In this way it will be seen that the sap may in reality be held in large part on pressure and leak as it appears to, in the maple, from the ducts cut off in tapping, as fast

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as their capacity will admit of. The variation is however very great. Dr. Williams, in his history of Vermont, says: "A man much employed in making maple sugar, found that for 21 days together a maple tree discharged 7 1-2 gallons per day." This would make a total of 157 gallons from a single tree. An American agricultural journal in 1842 stated that 20 gallons of sap was drawn in 18 hours from a single maple tree, 2 1-2 feet in diameter, in Warner, New Hampshire; Emerson in his "Trees of Massachusetts" mentions a maple 6 feet in diameter which yielded a barrel of sap in 24 hours, and of another tree that yielded 175 gallons in course of the season. A maple tree in this town for several years yielded on the average 30 pounds of sugar, which would necessitate about 600 pounds of sap per annum. In 1860 the owner of the sugar place in which this tree was situated made 2,160 pounds from 200 trees and the tree before mentioned produced 42 pounds. Last spring, Mr. Reed, who carries on this sugar place, though the number of trees has increased by the addition of second growth trees, averaged 6 pounds to a tree, and a large second growth tree in an open field, owned by a Mr. Lamson, was tapped and the sap boiled at the house, and run in small cakes for sale; their weight was 21 pounds. The sugar made in that locality is very free from the malleate of lime, or sugar sand, so called, that is so common in many sections. I have consequently examined the sugar place and section round about and found no visible cause why maple trees should run so much more sap in this special location; yet such is a fact. I have carried on some experiments elsewhere to see what fertilizing substance, if any, would increase the flow and sweetness of sap. I have met with signal success, and find that wood ashes will not only double the usual amount of sap, but will make it much sweeter. To have a marked effect a dozen bushels should be strewn about the tree extending some 5 rods from it in every direction. There need be none put within 8 or 10 feet of the tree. They should be put on in the summer previous, but the effect is for years. Plaster of Paris also will increase the flow. So will stable manure, or any other fertilizer, but not as much as ashes alone. The malleate of lime, which is such a bane to sugar makers, does not seem to be increased in amount by fertilizing.

I have found maple sap to flow at all seasons after sufficient cold to freeze the outside grains of wood, followed by a day in which the warmth would thaw the tree. During the past 25 years this has taken place here as early as September 20th, and as late in the spring as June 14, in which freeze the entire foliage of the maples were

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killed. The second crop of leaves came rapidly forward but were about one-half the usual size. Many plants and trees when they awake from their winter repose shed sap freely when punctured, and by experiments carried out by Prof. Clark, president of the Massachusetts agricultural college, it seems they show variety of pressure, and after a time the maple and some other trees will take in by suction large amounts of water which go into the circulation. In my own experiment I have endeavored to have coloring material absorbed in this way, but with slight exceptions have failed in the attempt, yet alkaline and brackish waters will be absorbed, resulting in all my experiments in the death of the tree. In relation to this subject thousands of queries naturally arise which are in the greater part, as I have before said, unanswered.

The reason why the maple secretes cane sugar, and birch grape sugar, or how any sugar at all is secreted, are some of the questions easily asked but not so easily answered. There is but a step in chemistry from starch to sugar, and that the elaborated sap of autumn would contain starch, and the fact that sulphate of lime in the soil will increase the sweetness of the sap, leaves us a chance for conjecture, that the change may be in accordance with well known chemical laws; yet just how it is accomplished may ever remain a mystery. How the sap is taken up and such a pressure maintained by the rootlets, which at the same time have the capability of inverting their power of work, is unknown. If a sprout from a root have the root extending from it cut close to the sprout, and then brought above the surface, the end cut at the sprout will not only discharge sap, but convey nourishment taken from the tree through other rootlets, thus showing its double action. Trees that do not shed much sap, may even be inverted when of considerable size, and the limbs answer as roots, and *vice versa*, showing double action. Some have accounted for the circulation of sap by capillary attraction and osmose action, as well as by various theories; but might it not be as well to allow something for the life action of the plant, as to try and account for it by theories that are not only unreasonable, but inefficient?

There must be a vital action of the life principle of the plant in some direction, or else we could not distinguish the dead from the living. May it not be as with the animal to secure its food; and may not different plants, as well as different animals, feed not only on different substances, but in various manners?

The immense amount of water taken up by the rootlets, and containing but little plant food, must be in some way expelled so the

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proper material may be used to increase the tree. This is evaporated through the leaves, and it will be seen that a large tree must evaporate hundreds of gallons every day when growing with rapidity. This then affects the atmosphere, giving an excess of moisture to the atmosphere in wooded countries.

There is much to study in reference not only to the flow of sap, or the manner of growth of the plants we raise for the use of man, but for our advantage it should be directed to the best and most economical manner of giving to each plant its proper food. I am now carrying on various experiments in that direction, and shall be glad to correspond with any persons interested in the same subject.

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VERMONT MERINO SHEEP-BREEDERS' ASSOCIATION.

By ALBERT CHAPMAN, Middlebury, Secretary of the Association.

Since the last report by the secretary of this association to the Board of Agriculture was published by the secretary of the board in his report of 1878, the association has issued the first volume of its register. Besides the 192 flocks given in the list published in the last report there were 10 more added and published in the first volume of the register. They are as follows:

	NO. OF SHEEP.
J. H. Close, St. Clairsville, Belmont Co., Ohio.	119
George Hammond, Middlebury, Addison Co., Vt.	119
Thomas Healea & Son, Ulrichville, Tuscarawas Co., Ohio.	22
E. A. Jennings, West Cornwall, Addison Co., Vt.	48
D. C. Ketchum, Sudbury, Rutland Co., Vt.	23
E. L. Needham, Whiting, Addison Co., Vt.	46
James E. Parker, " "	16
S. H. Rawson, " "	36
Rollin J. Smith, Sudbury, Rutland Co., Vt.	68
Wm. G. Willson, Richville, Addison Co., Vt.	86

These 10 flocks made a total of 202 flocks that were accepted and published in the first volume of the register. These flocks contained 15,324 sheep.

The first volume was issued in January, 1879, and has been very favorably received by breeders all over the country and by those versed in the matter of pedigree, and is acknowledged by the mass of breeders as the best authority on the pedigrees of Merino sheep yet published in this country. The best evidence of the confidence of breeders is the continued and largely increased patronage the Vermont Register has had for the past two years. In that time over 325 breeders have applied to have their flocks registered; of these, something over 60 have made application since the first of March last, and will not be accepted until the second volume is completed. Of the others, over 25 have been rejected; 237 have been accepted, though not all of the accepted flocks have been accepted entire, but a portion of some of them have been rejected. Some 10 flocks that

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have been under consideration have not yet been able to prove their claims to be received as pure bred.

The following flocks have been accepted to be published in the second volume and their owners have fully complied with the rules by payment of fees, etc.:

H. J. Adams, West Haven, Rutland Co., Vt..... 59
George Ashley, Otisco, Ionia Co., Mich..... 13
A. W. Baker, Highland, Oakland Co., Mich..... 7
Chauncey L. Barber, Castleton, Rutland Co., Vt..... 50
J. S. Bamber, Highland, Oakland Co., Mich..... 71
L. W. & O. Barnes, Byron, Shiawassee Co., Mich..... 12
D. C. Barbour, Bridport, Addison Co., Vt..... 40
O. C. Beals, Grand Blanc, Mich..... 31
J. G. Blue, Cardington, Monroe Co., Ohio..... 118
Nathan Bottum, Shaftsbury, Bennington Co., Vt..... 16
Wilkes E. Bozman, Blue Rock, Muskingum Co., Ohio..... 62
J. A. Bryant, Bethel, Windsor Co., Vt..... 48
F. A. Bresee, Brandon, Rutland Co., Vt..... 20
S. J. Brigham, St. Albans, Franklin Co., Vt..... 95
Hiram F. Button, Clarendon, Rutland Co., Vt..... 120
John L. Buttolph, Middlebury, Addison Co., Vt..... 100
Loan J. Burgess, North Hoosac, Rensselaer Co., N. Y..... 2
R. B. Carns, St. Johns, Clinton Co., Mich..... 22
Edward L. Castner, Centerburgh, Knox Co., Ohio..... 67
J. W. Carter, Randolph Center, Orange Co., Vt..... 40
G. S. Casey, Whiting, Addison Co., Vt..... 36
Charles Church, Bellows Falls, Windham Co., Vt..... 58
Jacob Clary, Cumberland, Guernsey Co., Ohio..... 17
Chester L. Clark, Middlebury, Addison Co., Vt..... 25
H. B. Close. St. Clairsville, Belmont Co., Ohio..... 44
H. S. Cross, Bridport, Addison Co., Vt..... 104
Henry Collins, Ira, Rutland Co. Vt..... 70
George Curry, Freeman, Licking Co., Ohio..... 51
Nathan Cushing, Woodstock, Windsor Co., Vt..... 50
C. O. Cudworth, Richville, Addison Co., Vt..... 29
A. & O. B. Davis, York Center, Union Co., Ohio..... 40
Chauncey T. Dean, Lapeer, Lapeer Co., Mich..... 7
H. J. Delong & Son, West Cornwall, Addison Co., Vt..... 103
James F. Delong, West Cornwall, Addison Co., Vt..... 50
James W. Dey, Devereaux, Jackson Co., Mich..... 30
Columbus Delano, Mount Vernon, Knox Co., Ohio..... 135
W. D. Dewey, West Salisbury, Addison Co., Vt..... 36
D. P. Dewey, Grand Blanc, Mich..... 30
Dean & Jennings West Cornwall..... 171
Homer DeWolf, Johnstown, Licking Co., Ohio..... 43
Adam Diehl, Milford, Oakland Co., Mich..... 33

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H. L. Doane, South Lyons, Oakland Co., Mich..... 37
C. C. Dorr, Grass Lake, Jackson Co., Mich..... 7
David Dodds, North Hero, Grand Isle Co., Vt..... 67
Daniel Durfee, Bristol, Addison Co., Vt..... 21
M. C. Edelblute, Newway, Licking Co., Ohio..... 25
Isaac Eells, Middlebury, Addison Co., Vt..... 63
F. H. Eldridge, Bridport, Addison Co., Vt..... 29
W. G. Emmons, Kenton, Hardin Co., Ohio..... 30
E. W. Farwell, North Randolph, Orange Co., Vt..... 30
C. M. Fellows, Manchester, Mich..... 101
W. W. Fisher, North Greenfield, Ohio..... 35
B. S. Fields, Cornwall, Addison Co., Vt..... 118
Freeman A. Foote, Middlebury, Addison Co., Vt..... 34
V. N. Forbes, West Haven, Rutland Co.. Vt..... 30
Fred M. Foote, Middlebury, Addison Co., Vt..... 17
Loyal W. Frost, Bridport, Addison Co., Vt..... 29
William French, New Haven, Addison Co., Vt..... 63
William Fullington, Hanover, Grafton Co., N. H..... 21
C. A. Fuller, Fairfield Center, Maine..... 18
Daniel A. Gale, Sudbury, Rutland Co., Vt..... 67
C. B. Gibbs, Hortonville, Rutland Co., Vt..... 52
Zadok Hard, Arlington, Bennington Co., Vt..... 80
W. L. Hamilton, Bridport, Addison Co., Vt..... 24
Wm. Hammond, Elba, Lapeer Co., Mich..... 11
W. H. Hazen, North Hero, Grand Isle, Co., Vt..... 21
Daniel K. Hall, Pittsford, Rutland Co., Vt..... 150
Thomas D. Hall, Pittsford, Rutland Co., Vt..... 50
William P. Hall, Pittsford, Rutland Co., Vt..... 146
Henry F. Hall, Middlebury, Addison Co., Vt..... 73
E. S. Hammond, Reading, Windsor Co., Vt..... 77
A. S. Harding, Pomfret, Windsor Co., Vt..... 41
C. S. Harris, Vergennes, Addison Co., Vt..... 54
J. D. Haines, Byhalia, Union Co., Ohio..... 18
E. A. Harrington, Shoreham, Addison, Co., Vt..... 57
E. C. Hathaway & Son, West Mansfield, Logan Co., Ohio..... 13
Henderson & Willson, Meigs Creek, Ohio..... 68
Robert W. Hemmenway's Estate, Bridport, Addison Co., Vt..... 63
J. F. Hemmenway, Chelsea, Orange Co., Vt..... 22
E. Rich Hendee, Pittsford, Rutland Co., Vt..... 44
W. R. Henry, Bloomingdale, Jefferson Co., Ohio..... 6
G. & L. Hendee, Pittsford, Rutland Co., Vt..... 121
F. S. Higbee, Pataskala, Licking Co., Ohio..... 84
Caton Hill, Johnstown, Licking Co., Ohio..... 42
C. W. Hindes, Addison, Addison Co., Vt..... 70
A. W. Hindes, Addison, Addison Co., Vt..... 18
David T. Holden, Pittsford Quarry, Rutland Co., Vt..... 173
John E. Hosmer, Romeo, Macomb Co., Mich..... 28

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James H. Hood, Grass Lake, Mich..... 50
George W. Hunt, Greenwood, McHenry Co., Ill..... 45
Hugh Huntington, South Charlestown, Clark Co., Ohio..... 32
John Hutchins, Jr., Macksburg, Washington Co., Ohio..... 39
Collis Ikey, Whiting, Addison Co., Vt..... 9
C. M. Inskeep, East Liberty, Logan Co., Ohio..... 18
Samuel James, Middlebury, Addison Co. 80
Sylvester B. James, Hoosac, Rensselaer Co., N.Y..... 85
David Jackson, East Addison, Addison Co., Vt..... 48
H. W. Jones, Shoreham, Addison Co., Vt..... 128
C. W Jones, Shoreham, Addison Co., Vt. 66
E. Kendall, Middlebury, Addison Co.. Vt..... 14
Jacob Keller, West Mansfield, Logan Co., Ohio..... 30
C. B. Kelsey, Whiting, Addison Co., Vt..... 31
E. Kellogg, Osceola Center, Livingston Co.. Mich..... 116
L. M. Kelsey, Ionia, Ionia Co., Mich..... 39
John Keith, Crooked Tree, Noble Co., Ohio..... 10
C. D. & C. Kenyon, Center White Creek, Washington Co., N. Y..... 120
Munson R. King, Clinton, Mich..... 4
Samuel P. Kimball, Woodstock, Champaign Co., Ohio..... 95
J. M. Lake, Wixon, Oakland Co., Mich..... 10
Charles A. Landers, Bridport, Addison Co., Vt..... 30
Gilbert H. Lane, Cornwall, Addison Co., Vt..... 12
D. C. Lane & Sons, Westerville, Franklin Co., Ohio..... 35
E. Lawrence, Fairfield Center, Maine..... 9
V. V. Lake, Appleton, Licking Co., Ohio..... 29
T. C. Lippitt, Monmouth, Ill..... 40
C. E. Lockwood, Washington, Macomb Co., Mich..... 11
Mavis & Dean, West Mansfield, Logan Co., Ohio..... 52
G. W. Matthews, Sunbury, Delaware Co., Ohio..... 32
C. W. Mason, New Haven, Addison Co., Vt..... 60
Joseph S. Martin, Range, Madison Co., Ohio..... 12
C. G. Martin, Rochester, Windsor Co., Vt..... 60
Oscar G. Martin, Rochester, Windsor Co., Vt..... 93
A. W. Maring, Mendon, St. Joe Co., Mich..... 49
J. V. McCulley & Son, Smithfield, Jefferson Co., Ohio..... 64
J. B. McKibben, Mount Vernon, Knox Co., Ohio..... 104
K. W. Merritt, Shoreham, Addison Co., Vt..... 40
Hiram Merrill, West Addison, Addison Co., Vt..... 71
Johnson Mehalin, Smithfield, Jefferson Co., Ohio..... 34
E. H. & H. E. Merrill, West Bridport, Addison Co., Vt..... 164
John B. Mead, Randolph Center, Orange Co., Vt..... 175
G. D. Miner, Middlebury, Addison Co., Vt..... 70
Mills & Green, Condit, Delaware Co., Ohio..... 461
J. S. & J. E. Montague, Woodstock, Windsor Co., Vt..... 70
James F. Moore, Shoreham, Addison Co., Vt..... 10
Wm. Moore, Layman, Washington Co., Ohio..... 11

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James A. Murdock, Crown Point, N. Y..... 51
F. A. Myrick, Bridport, Addison Co., Vt..... 72
B. J. Myrick, Bridport, Addison Co., Vt..... 31
Elwin Z. Myrick, Bridport, Addison Co., Vt..... 14
E. F. Needham, Whiting, Addison Co., Vt..... 23
S. J. Northrup, Shoreham, Addison Co., Vt..... 80
John Ogilvie, Hartford, Licking Co., Ohio..... 20
E. R. Outland, Zainesfield, Logan Co., Ohio..... 29
John Outland, East Liberty, Logan Co., Ohio..... 22
S. C. Parkill, Cornwall, Addison Co., Vt..... 37
J. M. Parker, Cornwall, Addison Co., Vt..... 15
George Pellet, Mendon, Jackson Co., Mich..... 14
D. H. Peters, Greene, Licking Co., Mich..... 79
D. W. Percy, North Hoosac, Rensselaer Co., N. Y..... 46
Chester Pike, Cornish, Sullivan Co., N. H..... 254
H. M. Powers, Shoreham, Addison Co., Vt..... 32
E. B. Pond, Whiting, Addison County, Vt..... 20
J. W. Pollock, Cedarville, Greene Co., Ohio..... 9
D. W. Prime, Brandon, Rutland Co., Vt..... 35
E. D. Pritchard, Cornwall, Addison Co., Vt..... 42
Cornelius Pugsley, Independence, Jackson Co., Mo..... 51
Wm. F. Quinn, Layman, Washington Co., Ohio..... 50
Mrs. Sarah Rathbun, East Shoreham, Addison Co., Vt..... 19
Joel Randall, Middlebury, Addison Co., Vt..... 260
John Raymond, Orwell, Addison Co., Vt..... 20
J. S. Rea. West Mansfield, Logan Co., Ohio..... 18
Wesley Robinson, Havanna, Huron Co., Ohio..... 128
A. B. Rose, Vergennes, Addison Co..... 36
H. T. & E. Ross, Milford, Oakland Co., Mich..... 32
Wilbur H. Root, Orwell, Addison Co., Vt..... 16
E. & G. Robinson, Ostrander, Delaware Co., Ohio..... 71
E. P. Rogers, Marysville, Union Co., Ohio..... 30
Jonathan Russell, Shoreham, Addison Co., Vt..... 16
J. R. Sawyer, Appleton, Licking Co., Ohio..... 76
G. A. & S. E. Seager, Brandon, Rutland Co., Vt..... 26
H. C. Sessions, Middlebury, Addison Co., Vt..... 75
Newton Shaw, Chesterville, Monroe Co., Ohio..... 44
Edwin R. Shedd, Brownsville, Windsor Co., Vt..... 130
E. J. Smith, Westport, Essex Co., N Y..... 96
D. C. Smith, Addison, Addison Co., Vt..... 70
Byron Smith, Addison, Addison Co., Vt..... 14
Asa H. Smith, Shoreham, Addison Co., Vt..... 23
J. Evarts Smith, Ypsilanti, Mich..... 228
Olin A. Smith, Addison, Addison Co., Vt..... 47
Cyrus H. Smith, Bridport, Addison Co., Vt..... 20
C. C. Smith, Bartlett, Washington Co., Ohio..... 64
J. S. Smith, Addison, Addison Co., Vt..... 47

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John H. Sprague, Vergennes, Addison Co., Vt..... 269
S. I. Spaulding, Middlebury, Addison Co., Vt..... 33
J. A. & V. I. Spear, Braintree, Orange Co., Vt..... 161
L. W. Spaulding, Middlebury, Addison Co., Vt..... 42
G. W. Stewart, Grand Blanc, Mich..... 47
J. W. Stevens, East Corinth, Orange Co., Vt..... 89
Robert Stewart, Hadley, Lapeer Co., Mich..... 60
S. & E. H. Stewart, Weybridge, Addison Co., Vt..... 12
William Staley, Marysville, Ohio..... 26
A. D. Taylor, Romeo, Macomb Co., Mich..... 50
H. E. Taylor, West Cornwall, Addison Co., Vt..... 10
John C. Thompson, Romeo, Macomb Co., Mich..... 54
Wm. Thompson, Layman, Washington Co., Ohio..... 11
A. P. Thornton, Castleton, Rutland Co., Vt..... 40
J. H. Thompson, Grand Blanc, Mich..... 60
S. W. Thomas, Greenwich, Huron Co., Ohio..... 300
J. S. Tilton & Son, Norwalk, Ohio..... 7
Lewis Treadway, Richville, Addison Co., Vt..... 102
A. B. Treadway's Estate, Richville, Addison Co., Vt..... 137
Mrs. Wm. Turner, Cornwall, Addison Co., Vt..... 68
Ira J. Twitchell, Weybridge, Addison Co., Vt..... 65
A. M. Tyler & Brothers, Alexandria, Licking Co., Ohio..... 60
W. C. Vandercook, Cherry Valley, Ill..... 35
Geo. H. Vaughn, Woodstock, Windsor Co., Vt..... 132
Henry E. Vaughn, Woodstock, Windsor Co., Vt..... 205
B. F. Van Vliet, Shelburn, Chittenden Co., Vt..... 29
G. R. Waite, Richville, Addison Co., Vt..... 9
R. K Willis, Lewis Center, Delaware Co., Ohio..... 338
R. H. Williams, Bartlett, Washington Co., Ohio..... 21
J. S. Wilmarth & Son, Addison, Addison Co..... 80
H. M. Wing, Rochester, Windsor Co., Vt..... 6
James S. Wing, Cornwall, Addison Co., Vt..... 29
Ashley T. Wolcott, Shoreham, Addison Co., Vt..... 35
L. W. Wooster, West Cornwall, Addison Co., Vt..... 64
E. H. Wooster, West Cornwall, Addison Co., Vt..... 11
John W. Wooster, West Cornwall, Addison Co., Vt..... 34
Uriah Wood, Brandon, Wisconsin..... 45
Martin J. Wright, Middlebury, Addison Co., Vt..... 29
Homer E. Wright, Bridport, Addison Co., Vt..... 37

The above 222 flocks have 12,887 sheep; besides these there are 15 flocks that have been accepted, but their owners have not yet complied with all the rules, and therefore they are not yet fully accepted for record, though no reason is known why they will not be. This will make the whole number of flocks, published in first volume and accepted for the second, 439, with a probability of 4 or 5 more

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from the 10 still undecided. The flocks already accepted are from the following states:

Vermont	304
New York	10
Michigan	36
Wisconsin	8
Ohio	68
Illinois	5
Missouri	2
Colorado	1
New Hampshire	2
Maine	3
Total	439

The total number of members of the association is 511.

FINANCIAL STANDING OF THE ASSOCIATION SEPTEMBER 6, 1880.

Cash on hand deposited in bank	$2311.30	
Good accounts due the association	231.20	
Books on hand	425.00	$2967.50
Liabilities		$31.50
Total assets less liabilities		$2936.00

OFFICERS OF THE ASSOCIATION FOR 1880.

President—E. N. BISSELL, East Shoreham.

Vice-Presidents—W. R. REMELE, Middlebury; C. B. COOK, Charlotte.

Secretary—ALBERT CHAPMAN, Middlebury.

Treasurer—MILO B. WILLIAMSON, Middlebury.

Directors—V. RICH, Richville; T. BROOKINS, East Shoreham; H. C. BURWELL, Bridport; FRED. H. FARRINGTON, Brandon.

Committee on Pedigrees—J. J. CRANE, Bridport; F. HOOKER, Cornwall; RECTOR GAGE, Addison.

Assistant Committee—Ohio, B. W. COPE, Smithfield, Jefferson county; R. K. WILLIS, Lewis Center, Delaware county. New York, E. TOWNSEND, Pavilion Center, Genesee county, PETER MARTIN, Rush, Monroe county. Wisconsin, C. D. MCCONNELL, Ripon; C. M. CLARK, Whitewater. Michigan, JOHN T. RICH, Elba, Lapeer county; A. D. TAYLOR, Romeo.

The labors of the association and its expenditures of money have been very largely repaid by a greatly increased demand for the Merino

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sheep of Vermont, and at larger prices. During 1879, 45 car loads were shipped from the Middlebury station alone, to different states and territories, while a large number of car loads were sent from other stations in the state.

The result of the exhibition of Vermont wools at Paris in 1878, by the association, was very gratifying, and on the whole surprising, in view of the great competition and the prejudice that has existed against the heavy wools of Vermont. There were three gold medals awarded to wools from the United States, and all on wool shorn from sheep recorded in the register of this association; of these three, two were awarded to Vermont wools. There were three silver medals awarded to wools from the United States; of these one was awarded wools from Vermont. There were thirteen bronze medals awarded on wools from this country; of these the Vermont wools received eight. The following is the list of the prizes:

GOLD MEDALS.

George Campbell, Westminster West, Vt., Luman P. Clark Addison, Vt., E. Townsend, Pavilion Centre, N. Y.

SILVER MEDALS.

O. & E. S. Hall, East Randolph, Vt., Samuel Archer, Kansas City, Mo., E. J. Hiatt, Chester Hills, Ohio.

BRONZE MEDALS.

H. C. Bunnell, Bridport, Vt., H. M. Bottum, Shaftsbury, Vt., Edgar Sanford, West Cornwall, Vt., F. & L. E. Moore, Shoreham, Vt., Henry Harrington, Keeler's Bay, Vt., J. T. Stickney, Shoreham, Vt., C. B. Russell, North Hero, Vt., Milo I. Ellsworth, Cornwall, Vt., W. G. Markham, Avon, N. Y., E. Clelland, W. Pierpoint, J. H. Blaine, Mark Durand, residences not given.

HONORABLE MENTION.

C. P. Morrison, Addison, Vt., T. Stickney & Son, East Shoreham, Vt., G. F. Martin, Rush, N. Y., Bronson & Mainner, West Bloomfield, N. Y., and J. Fobes, J. C. Short, —— Simmons, residences not given.

The association sent a larger amount of wool to Australia to be exhibited at Sydney, last winter, and at Melbourne the coming winter.

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We have been advised that it drew prizes at Sydney, but have not received any definite particulars.

These triumphs of Vermont wools abroad, as well as the distribution of a large number of copies of the first volume of the register of the association, in foreign countries, is attracting a great deal of attention to the great improvement the breeders of Vermont have made upon the Merino sheep imported from Spain in the beginning of the present century, and a very general acknowledgment from experts and breeders abroad, of the very superior excellence of our sheep, and it is very confidently hoped that the labors and expenditures by this association will result in largely increased demands for our sheep abroad to improve those in other countries.

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ENSILAGE.

By the Superintendent.

The question whether our fodder of various kinds can be preserved so that at any and all times it will furnish to our domestic animals the most nutritious and economical food, is a very practical one. If it be possible to present to the farmers of New England a feasible process by which he may grow a steer as well in winter as in summer, and as cheaply, or make as much and as good butter when the snow is flying and the thermometer at zero as in June, then may he congratulate himself upon the new era of farming and be grateful for the discovery of ensilage. The present state of this system is the result of careful experiments for many years, made by M. Auguste Goffart of France, whose early success was, to use his own words, "far from being complete," and who has been led to change very much his early views and practices, so that, "I can to-day," says he, "recommend to my agricultural brothers a complete system of ensilage, applicable to all green crops without distinction, and can guarantee to them an entire success if they will follow to the letter all my directions" This treatise of M. Goffart's has been translated by Mr. J. B. Brown of New York and is of value to any one contemplating a trial of the system.

Mr. John M. Bailey, of Billerica, Mass., has also published a book giving an account of his experiments in the same direction with flattering testimony in confirmation of all that M. Goffart claims, and in a letter to the *Country Gentleman* says:

"'The Winning Farm Silos' are a perfect success. The preserved corn fodder which was cut about 4-10 of an inch long, and placed in the silo about the last of September, and subjected to heavy and continuous pressure, is being fed to the stock. They all eat it with avidity. Its preservation is perfect. It has an alcoholic odor and is somewhat acid. My stock eat it all, lick out their mangers and look wistfully for more. When the silo was first opened, December 3d, there appeared to be

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a strong acidity, so much so that some of the gentlemen present were somewhat disappointed; but as we got farther into the mass of ensilage the acidity is much less, while the alcoholic odor upon exposure to the air several hours is much stronger. I tried a little experiment with it this afternoon. I had a pen of 7 Oxfordshire-downs and another pen of 5 Maple-shade Cotswolds. They had just been fed with some bright clean hay. In another feed trough I put some ensilage. Five of the 7 Oxfordshire-downs left the hay and ate the ensilage and 4 of the 5 Cotswolds did likewise, I feed, in place of the ration of hay, 25 to 30 pounds of ensilage to each cow in the morning, and the same at night, which has lain upon the barn floor all night, during which time fermentation is quite active, so that it is warm in the morning. The ensilage in the silo which is compacted, although exposed to the air, seems to undergo no change, It is pressed so hard that the air cannot enter, and therefore does not affect it at all. I am delighted at the success of the enterprise. I believe it is possible to keep 4 cows a year upon corn fodder ensilage raised upon 1 acre of land. Verily, we are under the greatest obligation to M. Goffart and to J. B. Brown—to the former for demonstrating to our satisfaction that corn fodder can be successfully preserved in this manner, and to the latter for *translating* M. Goffart's work into English so that we may profit by his great success. If he is truly blest who causes 2 blades of grass to grow where only 1 grew before, how much more to be honored is this man, who has taught us how to keep 4 cows upon an acre of land where 1 cow would find but scanty subsistence before! A most fortunate agricultural revolution is indeed impending, and one which I trust many of our progressive farmers will engage in during the coming season. JOHN M. BAILEY.

'Winning Farm,' Billerica, Mass."

Mr. Bailey gives, in addition to his own well attested statement as to the value of the system, the opinion of Mr. Henry B. Judkins, a neighbor of his, as follows:

"JOHN M. BAILEY—*Dear Sir:*—In accordance with my suggestions made on the occasion of the opening of your silo, December 3d, I have used your ensilage in manner as follows: My small herd of 6 cows calved early in the spring, viz., in the months of March and April. They are of the ordinary New England stock, with no pretensions to any pedigree. I sell no milk; and my cows, such as they are, were selected more for their butter-making qualities than for any extra milking qualities. These cows had served through

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the season for butter-making, and with the commencement of cold weather and the stoppage of 'fall feed,' had begun to shrink in milk.

Previous to the use of your ensilage the 6 cows had been fed 2 bushels of flat turnips, with 4 quarts of bran to each cow daily, and what dry corn fodder they would eat. The amount of milk given by them daily was 30 quarts, from which 18 pounds of butter were made per week. I commenced using your ensilage on Wednesday, December 10th, and left off using it on the 17th, feeding 18 barrels, or 54 bushels, during the week. All but 1 cow took to the fodder at first kindly, and their appetite for it increased from day to day. There was an increase of milk from 30 quarts to 35 quarts daily. The cream was thicker, of richer color and of better quality, than from their previous feeding. One sack of bran of the value of 90 cents was all that the cows ate during the week in addition to your ensilage, except a small amount of bog or meadow hay of nominal value.

The account for this week would therefore be for the 6 cows:

54 bushels ensilage (1,620 pounds) at $.001	$1.62
1 bag wheat shorts	90
	$2.52

The cows should be credited with 22 pounds of butter at 35 cents a pound and say 210 quarts of skim milk at 1 cent per quart, which I consider its value as feed for the pigs.

22 pounds butter at $.35	$7.70
210 quarts skim milk, $.01	2.10
	$9.80
Cost of keeping	2.52
Profit	$7.28

The flavor of the butter was excellent, and its color a good yellow, equal to that which sweet pasture gives.

In the brief statement, I have confined myself strictly to facts, and will make no comments, except to say that I am convinced that your method of preserving green fodder for use in winter time is a success and will eventually be adopted in this part of the country.

HENRY B. JUDKINS."

We give further some figures of Dr. Bailey's:

"I have a Jersey heifer 20 months old which has doubled her yield of milk since I began to feed ensilage. I have one cow 13 years old which came in December 1st, three weeks ago. She is now giving 16 quarts daily upon 60 pounds of ensilage and 4 quarts

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of shorts. I am feeding 35 head of cattle and 100 head of sheep upon 45 bushels (about 1,350 pounds) of ensilage and 80 cents worth of shorts, and less than 50 pounds daily. I cannot make the cost of corn ensilage to be more than 1 mill per pound, or $2.00 per ton.

It will therefore be seen that the expense of keeping 35 horned animals and 100 sheep at 'Winning Farm' is as follows:

1,350 pounds of ensilage at $.001	$1.35
90 pounds of shorts	80
50 pounds of hay at $15.00 per ton	37½
Total cost per day	$2.52½

The cost of keeping the above stock upon hay and grain would be as follows: 20 pounds of hay to each animal (10 yearlings counting as 5 cows), making 30 head, would require daily as follows:

600 pounds of hay for cattle at $15.00 per ton	$4.50
200 pounds of hay for 100 sheep at $15.00 per ton	1.50
120 pounds of shorts for cattle at $18.00 per ton	1.08
40 pounds of shorts for sheep at $18.00 per ton	36
Total cost of keeping 30 cattle and 100 sheep per day on hay and grain	$7.44
Cost of keeping the above on ensilage as above	2.525
Daily balance in favor of ensilage	$4.915

Dr. Bailey further says:

"From my experience in feeding, so far, I consider ensilage to be worth one-half as much as the best timothy hay. I would not, however, exchange ensilage for hay and give 2 tons for 1. I believe that 40 to 75 tons of corn fodder can easily be raised upon an acre, which if properly ensilaged will be equal to from 20 to 37 1-2 tons of hay. To receive the fullest benefit, however, I think there should be some nitrogenous food, such as oats, shorts, pea or bean meal, oil meal or animal meal, fed with the ensilage."

And in closing his enthusiastic and interesting remarks upon the value of the system, in which is the expressed belief of Secretary Chas. L. Flint of Massachusetts, "that the system of ensilage would work a perfect revolution in agricultural methods in this country," he says: "The system of ensilage reduces the comparative value of good timothy hay to $4 per ton, and of hay barns to $2 for each ton's capacity. The labor of feeding is lessened very materially; the health, condition and appearance of the stock is immeasurably

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improved. In short, it will bring about upon its general introduction and adoption, an agricultural millennium—almost."

In company with Gen. Stephen Thomas of Montpelier I visited Dr. Bailey's farm, in May last, and we were much pleased with what we there saw. A small portion of the corn ensilage, put in the September previous, yet remained. The cattle ate it greedily as we offered it to them, even between feeding hours. A stable full of cows in different stages of the milking period, were in sleek and fine condition, while some that were dry were fit for the shambles. The Dr. told us he fed about 30 pounds of the ensilage to each animal, daily, with a small amount of nitrogenous food in the shape of oat meal, or oil meal, or bran as the complement for a complete ration. All of the stock at Winning Farm we saw, that had been kept upon ensilage, looked hearty and thrifty. Gen. Thomas was so favorably impressed that I think he then and there resolved to make the experiment upon his own farm, and we are glad to record that he has put that resolution into practice, the present season, and proposes to test the system for Vermont and Vermont farmers. The work of such men as Gen. Thomas and Gen. Grout of Barton, who is also testing the system upon quite an extensive scale at his fine farm in Kirby, this state, in experimenting. in the untried fields of modern agriculture, is of incalculable benefit to the rest of us who are farmers, as well as advantageous to the world at large. Discoveries and achievements that are valuable, always, or nearly so, are the result of much careful and pains-taking, and often costly, experiment. And it has been left, comparatively, to a late period for the grand and signal successes which have crowned the labors of men in the interest of agriculture. What wonders have been wrought for us to review in the last quarter of a century, and if we go back fifty years most of what is now valuable to us was then unknown. We cannot compute the worth of such men as Baron Liebig to the agricultural world, who in 1840 discovered and proposed the treatment of bones with sulphuric acid for the manufacture of phosphate of lime, which at once thereby became more rapidly soluble and consequently ready for use by the crops with less loss of time. This was the foundation of a system of agricultural science which has been deep-

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ening and widening with the years, by the aid of such men as Messrs. Lawes and Gilbert of England, and all careful students and experimenters in this country, who will not rest satisfied with present achievements. We are indebted to the gentleman of means, or of leisure, or both, who is willing to spend his time and money in settling such questions as are of moment to us. And many of us are watching with interest the success of the silos built this year in Vermont. I have heard of but two more in addition to those of Gens. Thomas and Grout, viz: Mr. Gilbert Morton of Essex and Mr. Green Griswold of Randolph. I have not visited Mr. Morton's, but understand he is much pleased with it, and that his neighbors are somewhat of a doubtful mind concerning it, but are hopeful. Mr. Griswold has one 8x11 feet and 18 feet deep, into which he put three acres of corn, and it was not full. He has another smaller one in which he has put rye, and is much pleased with it thus far. Gen. Thomas writes:

"My Dear Col.:—In reply to your inquiry relative to my silo, I have to say: I made an excavation in an elevation of ground and laid in cement split stone, making the interior 15x40 feet and the walls 15 feet high. These I plastered with cement and also cemented the bottom so as to make the walls and bottom water and air tight. This will hold about 270 tons when properly filled. I had between five and six acres of corn planted in drills and rows 3 feet apart, very heavy growth; farmers who saw it were of the opinion the silo would not hold it, but it did not fill it over one third full. I commenced cutting it on the 20th of September and completed it on the 23d. I then put upon the top of it about six inches of rye straw; upon this I laid 1 1-2 inch spruce plank and loaded them heavily with stone. I think the weight of stone should be from 125 to 150 pounds to the square foot in silo, and I think boards better than plank for they will bend and conform to any uneven surface there may happen to be. I have no doubt about keeping corn fodder in silos, when cut fine and properly weighted immediately after it is put in the silo, an indefinite length of time. Neither do I believe it possible for farmers in Vermont to get one-fourth the value of fodder from any crop they have been in the habit of raising, as they can by ensilaging corn; and I think the system will be applied to all fodder crops, thereby saving all the nutrition and insuring the consumption without waste by the cattle of the entire crop. The labor of getting corn into a silo is not as much as it would be to cut, bind and stook

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it. I also am of the opinion that hay can be ensilaged cheaper than it can be harvested as we have been in the habit of doing it, and we should not be dependent upon the weather, as it can be put into a silo at any time unless it is *very* wet, and all fodder is better not to be wilted before it is put into a silo. I shall be very happy to give any information or answer any questions which I am able, to you or any one else who may wish for the same, for I believe the system will be of great advantage to our state.

Yours truly, STEPHEN THOMAS."

Gen. Grout, in response to my invitation to give a short account of his experiment this year in ensilaging of corn, and what his opinion thus far formed was, writes as follows:

"Yours is received, asking dimensions of silos put in this summer; also opinion as to the practicability of the system for the average farmer. One is 18 feet long, 12 feet wide, 13 feet deep, the other 45 feet long, same width and depth. Expense of the two, $412. Just about 11 acres of corn fodder of good growth was put into the larger one early in October, completely filling it, though now under about 2 feet of stone on the covering boards it has settled perhaps 3 feet. There must be from 150 to 200 tons of the ensilage. Fifty or 60 pounds is a daily ration for a cow. If there be 150 tons, and there cannot be less, feeding 60 pounds per day, it will keep 25 cows 6 months. Add a small ration of oil cake or cotton seed meal, or meal of any kind, say of the value of 2 or 3 cents per day, and all testimony concurs in proving that they will be better kept than upon hay alone. What I saw last winter at Dr. Bailey's farm in Billerica, Mass., satisfied me of this. I believe, however, in our state, abounding as it does with sweet, luxuriant grasses, pressed corn fodder will never wholly take the place of hay; and instead of being the main food of bulk, should be fed with hay, say 1 feed of the ensilage and 2 of hay per day, but can tell better about this after trial this winter. I have no doubt of the just economic value of pressed corn fodder; and corn is unquestionably the plant from which the most profitable results can be realized, for the reason that such an immense quantity can be produced from so small an acreage, and because, also, it so little exhausts the soil, being fed largely from the atmosphere. Most certainly if the system is of value to any one, it must be to the average farmer. It will surely help enrich his farm, and enable him to produce thrifty animals.

The expense is within his means. A silo that will store the corn fodder from 10 acres will cost $300—perhaps $400—unless it can

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be placed inside some building and thus save an independent covering. A cutter will cost another $100, but one cutter would answer for a neighborhood. The neighborhood threshing machine horse power will serve as power; that is all except to produce the crop and put it in the silo and this can be done for less than $2 per ton. What the system claims is to produce a fodder of greater keeping capacity for the money and with less exhaustion to the soil, than by other yet known. If it does this, and it seems quite clear that it does, it must be valuable alike to the large and small farmer.

Respectfully, etc.,

WM. W. GROUT."

We will now wait for further developments, hoping much from the "new dispensation," yet reserving our final judgment until another year.

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AN ADDRESS.

By Hon. J. GREGORY SMITH, Delivered at Bethel, at the White River Valley Fair, September, 1879.

Mr. President, Gentlemen and Ladies:

I confess to great diffidence in appearing here to-day. The occasion, the assemblage, the objects of your gathering, all serve to remind me that one more skilled than I am, educated more thoroughly in your pursuits, and with a knowledge gathered from ripe experience, would interest you more than I can hope to do. I therefore crave your indulgence while I submit a few thoughts, thankful if I succeed, even in some small degree in entertaining you.

Vermont is pre-eminently agricultural in all her interests—unlike her sister states, she has no predominant commercial or manufacturing industries, and no controlling financial centres. She prospers or declines in proportion as her farming interests are successful or depressed. Whatever, therefore, tends to prejudice the material prosperity of this, her staple industry, at once reaches the vital interests of her people.

It may not, therefore, be unprofitable for us to consider briefly some of the causes that have operated to produce the present depression, and to seek, if possible, a partial remedy.

The various periods of development and growth in agriculture in this state are familiar to you all. In its wilderness state the forest contributed the largest proportion of wealth. Its stalwart growth of pine, and hemlock, and spruce, each in their turn, gives ample occupation to its sparse population, and the natural highways of river and lake afforded easy and cheap transportation of its products to market.

The clearing process was soon accomplished. The busy ax and buzzing saw had done their work. The primeval forest was stripped of its glory, the broad acres were prepared for the craft of the husbandman, the plow and harrow followed the ax and saw, fields of waving wheat and corn dotted the landscape, and the virgin earth yielded a bountiful return of golden grain.

But soon the diminished crops gave evidence that the soil was being exhausted of those elements necessary for the profitable growth

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of wheat. And then sheep, and cattle, and horses succeeded, and the hills and valleys of Vermont became the best grazing fields of New England. Her beef held a high value in market, the wool of her sheep commanded a ready sale by the quality of its staple. On the products the state flourished and pursued her onward course toward competency and wealth.

The railroads gave new and fresh impetus to her agricultural prosperity. Until then the products of the dairy were extremely limited. Butter and cheese were almost entirely objects of barter with the local merchants. But the opening up of regular and expeditious communication with an extensive market, the introduction of methods for preserving butter in its transit, so that it arrived fresh and hard as when it left the hands of the careful dairy maid, with the aroma of the sweet mountains faced upon it, gave a stimulus to its production that elevated it to the highest marketable value and established for it an unrivaled reputation. Increased wealth began to flow into the state; the ever growing demand served only to augment her product until, according to the statistics of the last census, its aggregate for the entire state that year was over 17,800,000 pounds of butter and over 4,800,000 pounds of cheese, which at the then average prices of these two commodities yielded the dairymen of the state the enormous sum of over $5,500,000.

For many years Vermont held supremacy for the dairy commodities. This was the legitimate result of the natural order of things; and while this order remained undisturbed the flow of wealth to the state and the commanding position of control of the market were necessary sequences.

But while the great law of development and growth was working its natural results in Vermont to bring its agriculture to the highest position of profit, the changes which it wrought were not confined to the narrow limits of her own boundaries. Many now listening to me will recall how, when the exhausted lands in the state failed to make a profitable return in wheat, and her farmers were forced to resort to their flocks and herds, the great valley of the Genesee, in the state of New York, became the source of supply for this cereal, and Genesee wheat and flour, before unknown in this state, were found in almost every hamlet and household.

And soon again the lands of the Genesee gave way to the richer soils of Ohio and Michigan. The vast wheat fields of these states supplied bread-stuffs to the east, while flocks and herds grazed the hillsides and valleys of Genesee; and so, ever receding to the west and north-west, virgin states and territories were developed, till

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passing Wisconsin, Iowa and Minnesota, each in turn enacting their part in the problem of growth and supply, the broad and fertile prairies of Dakota now loom up and hold first rank in the product of wheat, while Wisconsin covers her fields with flocks and herds and chequers her landscape with spacious creameries for the manufacture of her rich dairy products.

But while this wonderful evolution has been going on in the development of agriculture, other elements have been introduced—the great law of compensation has been steadily working its way—territorial enlargement and the area of productive capacity has been accompanied by a corresponding growth in population to the east. A higher type of civilization has been developed, new industries have been created, inventive genius has wrought marvelous results in the arts and sciences, manufactures have grown and expanded until new wants have been created, the area of consumption has been enlarged, and the demand has kept pace with the ever increasing supply. The decade now drawing to its close has been wonderful in its progressive results. The accepted theories and methods of 10 years ago are now to a large extent rendered obsolete, and find their refutation in the more modern inventions and appliances. It was broadly asserted at that time by a learned political economist in an essay on "The Relation of Agriculture to Other Industries" that although wheat, corn, barley and oats might bear transportation to foreign countries, the more valuable and remunerative agricultural products were not exportable beyond the seas. Among these he enumerates potatoes, orchard products, beef, mutton, butter and eggs, and asserts that these can be profitably produced only in the neighborhood of an easily accessible market sustained by diverse industries and avocations. The proximity of the great manufacturing districts of New Hampshire, Massachusetts and Connecticut and the commercial city of Boston with its teeming population has no doubt contributed in a large degree to the advantage of farmers in this state.

But the newly developed foreign demand for these products has opened a wider field and added new impetus to the farming interests of this country. It is now no longer true that the more valuable and remunerative of all agricultural products are not exportable beyond the seas. The recent introduction of refrigerator compartments into the ocean steamers and the improved methods of construction of refrigerator cars make the export of butter, eggs, poultry and fresh fruits of all kinds of orchard growth, as well as dressed beef and other fresh meats, not only possible, but a matter of al-

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most daily occurrence, while cattle, hogs and sheep, as well as horses, are exported in large quantities and at remunerative prices to the producer. The revolution in trade has become a large factor in determining the question of the profitableness of farming, while the stimulus thus given to this branch of industry has enacted an increased activity in manufactures, till now, the producers of metallic and textile fabrics in this country are finding ready markets for their products in foreign lands.

In its effect upon the finances of the country the most gratifying results are noticeable. The tide of wealth has changed, the exports are, and doubtless for a long time will continue to be, largely in excess of imports, the gold of other countries is borne across the broad Atlantic to our shores to be distributed among our own people; the husbandman is to receive the rich reward for his toil; the citizen is to be stimulated in his art; the manufacturer catches the awakened impulse and is incited to increased activity and skill in his product, and in every department of industry new stimulus is felt, new hopes are incited, and an era of prosperity is opening full of promise and encouragement. The change from the position held by the state in the early development and progress of our dairy interests to that which she now holds has been great, and no doubt to this cause, in part, may be attributed the present depression in her affairs. Instead of now controlling the market, she has to contend with active rivalry, and that, too, from powerful competitors. The same laws by which she was reclaimed form the wilderness state and brought by successive steps of progress to a high standard of excellence in her products have also operated to reclaim and elevate the states further west, and the competition and rivalry of the multiplied transportation lines with all the modern improvements have placed the more remote products on nearly the same level with those nearer the markets.

In most of the farm products other than dairy the great west has gained the entire control. In beef and cattle the markets of the world are almost everywhere from the western fields. The wool has been almost entirely monopolized by her—with her breadstuffs she feeds not only the millions of our own population, but the lands far over the water hundreds of millions of bushels of grain from her vast granaries, while in the great staple of Vermont—the dairy—the west is making rapid encroachments upon us. Where, only the brief period of a few years ago, nowhere in the west could be found a print of butter that was even tolerable, now Illinois, Indiana, Michigan, Wisconsin and other western states are sending daily into

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the eastern markets their butter of the finest quality to compete with ours and command an equal, and not unfrequently a higher price.

This mighty west! Where is its beginning, and where its end? What are its boundaries? It confronts in all our plans for progress in wealth. It rises spectre-like to disturb our peace. Its vast domain, its diversity of soil and climate, its productive power, its inexhaustible resources, fill us with constant wonder and bewilderment. We gaze in almost speechless awe as we look upon its vast prairies, stretching out before us in long level lines, bounded on either side only by the limit of our own vision, now an uninhabited, silent wilderness covered with most luxuriant verdure, rich in undeveloped wealth, and now dotted here and there with the settler's hut, the home of the adventerous and hardy pioneer; and again, in a brief space of time, covered with well cultivated fields of grain, with villages and embryo cities rising like magic from out the solitude, and still again the countless herds of cattle and the dairyman's spacious buildings, all reminding us that here, indeed, is the future seat of empire, the vast granary of the world, the prospective home of millions that are to work and labor and struggle in the great conflict of life. It is, indeed, the miracle of the age.

It was the remark of a distinguished stranger, who had traveled extensively over this vast country, that "It was a godsend that the Pilgrims first landed on the rock-bound coast and forbidding soil of New England, for," said he, "had the valley of the Mississippi and the rich country contiguous to it been first inhabited, New England would have remained to this day a barren, sterile and an uninhabited region." In a higher sense than was meant by this stranger gentleman, it was, indeed, a godsend, for but for the influence which New England men and New England character have exerted, that great empire of the west would never have been what it is to-day. It needed a hard and fierce conflict with the stubborn and rocky soil of New England to develop character, to bring out those elements of industry, frugality, honesty, sobriety, that stern sense of justice and love for the right, that sound and well balanced judgment, that respectful awe, and that noble and unselfish patriotism which distinguished New England character, and which has permeated the western empire, and been in all that tremendous growth and progress the guiding star and the mighty ruling force. It is the perpetuation of New England institutions and character which is, still to give security and permanency to that growing country. It was wisely ordained that this wild and rocky coast should first greet the

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wandering Pilgrims. It was with equal wisdom that those broad and fertile prairie fields were so long withheld from settlement, aye, and are yet so largely withheld, for, stretching on and on towards the setting sun, far beyond the outer limits of present civilization, are to be found fields of surpassing fertility and beauty, broad acres yet to be opened up to the hardy settler, and hidden treasures yet to be developed to give support and power and untold wealth to the Nation. With all these, we have yet to contend as they are successfully developed in the great rivalry for the products of this state. It is idle for us to close our eyes to the great facts; they are the result of an inevitable law of growth and expansion of territory and population. No human agency nor power can stay the onward march of empire. "Westward still it takes its way," and each succeeding year but adds increased impetus to its already accelerated progress.

The great problems that now agitate all Europe, disturbing its quiet and producing discontent and unrest among its overcrowded population, only serve to add fresh incitement to the rapid development of the great territory of the west and north-west, and each new acre of its fertile soil opened to the plow adds increased competition to the cultivated fields of the east.

The sooner, therefore, we accept these great facts and conform to them intelligently as inevitable destiny, the sooner will the farming interests of this state be placed upon a firmer and sounder footing. Discontent and murmuring complaints will not effect a cure. Legislation is powerless. Supine submission and abandonment of the vantage ground already held is but cowardly surrender, unworthy of Vermont and her people.

I have in this view made no reference to other and to my mind minor causes of the present depression of the agricultural interests of the state, for the reason I regard them but as temporary and incident alike to every industry in the whole country. The periods of financial distress which has so long and to such a fearful extent prevailed throughout the United States and, indeed, throughout the civilized world, whatever may have been its cause, has had its share in producing distress and prostration in the farming interests of this state in common with others. But these by the great laws of political economy re-adjust themselves as naturally and inevitably as they were produced, and hence in due course of time will work out their own solution. Already we see hopeful signs of relief. Prosperity shadows forth its approach unmistakably, and to the extent that these elements have contributed to the depression of industrial en-

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terprise, relief will soon be experienced. I have had reference, therefore, to none of these minor causes. I have to deal only with those elements and causes which in their very nature are permanent and which demand a higher consideration and study than the other and more ephemeral. Is there, then, a remedy for this condition of things, and in what does it consist?

Bravely have you struggled for the commanding position which you have hitherto held. From the hillsides and valleys of this proud little mountain state you have by steady and persistent effort achieved an enviable success. Shall it be ignobly surrendered?

There is no state in the Union capable of a higher standard of excellence and more profitable results than this. Nature has been lavish of her gifts to Vermont. The conformation of country, her uplands and valleys, her healthy and invigorating climate, her pure, sweet mountain streams and springs of water, the diversity of her soils, all conspire to give her proud pre-eminence for the vast results in agriculture, while for her people in point of intelligence, in simplicity of habits, in frugal industry and patient inquiry, as well as for high moral and religious attainment, she may challenge comparison. Possessed of all these elements of power and strength, she has to turn only to herself for the solution of the great problem which to-day vexes and disturbs her, and to find here the remedy for the present difficulties. It is an old and, perhaps, a truthful saying that he who can make two blades of grass grow where but one grew before is a benefactor to his race. Herein lies the secret of your success as farmers to-day, and while there may be and is to the man who succeeds a conscious satisfaction in the thought that he has performed a commendable deed, and accomplished a result beneficial to his race, there will also be more selfish and sordid, but perhaps none the less satisfactory consciousness, that he has thereby made a gain in his own coffers.

Vermont's greatest need to-day is a higher standard and a more perfect and intelligent system in the various departments of her agriculture. Thoroughness in farming is the grand secret of success; it is a truth with an emphasis that he who tills with greatest care and enriches with largest bounty, reaps the greatest reward. In all her bounty and magnificence, nature has not provided her a soil that will produce in perpetual spontaneity and rich abundance for the supply of man's wants and to satisfy his.

She demands a full and ample return to the soil for the bountiful harvests which she yields, and as if to leave man without excuse for neglect to obey this great and fundamental principle, she has in

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most significant form given example of her own methods and the rich results. On the banks of the river Nile, that beautiful river, renowned in history, the seat of art and science, and the highest type of ancient civilization, the sources of whose perpetual flow were for ages an enigma and a wonder, there is a belt of land extending in length for hundreds of miles, and in width not exceeding an average of 5 or 6 miles, which for fertility of soil and capability of product is to-day, as it has been for thousands of years, the wonder and admiration of the world On either side of this narrow belt, and stretching far away in the distance, almost without limit, is the barren, fruitless, verdureless desert of sand.

On the confines of this fertile belt and in its contact with the sandy desert is the ever continued struggle between sterility and fertility, between healthful and vigorous growth and the starved and stunted vegetation which are everywhere the type of successful or ill-directed husbandry. With liberal and most bountiful hand, from season to season and always in its season, nature supplies the needed nourishment to this belt of land. The waters of the mighty river as they flow from their source come laden with the richest fertilizers, and in its period of overflow deposits these upon the surface of the land, and thus ensures to the husbandman a certain and bountiful harvest. Let us heed the lesson here taught, and see if we may not find profit in its teachings; the sandy desert with its unfruitful, forbidding soil is but a type of our soil in its natural state. The methods and processes of fertilization, it is true, are different, but in principle and effect may be realized here, and the results, if not as startling as there, will at least reap a rich reward.

Improvement in every department of farming in this state is needed if you would successfully contend with the difficulties to which I have referred. Your meadow lands must be made by thorough drainage and more bountiful fertilizing to yield a larger and better product. Your grain fields need to be more thoroughly cultivated and enriched, the plow and harrow must be made to do their work with more care, in order to bring your lands into higher tilth, and the fertilizing material must be applied with a more generous hand. Where the average yield of corn per acre to-day is scarce 40 or 50 bushels it should be brought to 60 or 80. Care and labor and intelligent study of your soils, and the best materials for fertilizing only are required to accomplish this. Even 20 or 25 per cent increase of the average for the state would astonish you by its return of wealth, and yet the enhanced cost of production will be but comparatively small.

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Your pasture lands need renovating and enriching, not only to increase the quantity but to improve the quality of the feed. It is stated by intelligent and observing farmers that the pastures generally in the state have deteriorated rapidly within the last few years; that they will neither support the number of cattle nor produce the quality of beef or dairy products they formerly did. And to this cause doubtless may be attributed, to an extent at least, the general decline in the prices of your products.

The statistics of the last census exhibit a condition of affairs with regard to your dairy interests which are worthy of your most serious consideration. Of the number of cows then in the state and the total yield of butter for the year I find but an average to the cow of a fraction over 98 pounds; while in one of the counties of the state the average to the cow is 124 pounds. At the present ruling prices of butter the average to the state give but about 12 to 14 dollars per cow, while in the county referred to, at the same prices, the yield per cow would give 16 to 18 dollars, a difference in favor of the county from 3 to 4 dollars per cow more than the state average; while if the general average in the state were brought up even to the average of the county the annual increase of wealth added to the dairymen of the state would have been nearly $700,000. I fail to observe any valid reason why this average may not by proper care in breeding and feeding be increased to 150 pounds; surely not any extravagant average. I doubt not there are farmers before me to-day who have cows in their herds which will yield far beyond this limit. With an average increased to 150 pounds per cow the enormous sum of over $1,200,000 would be added to the revenue of the dairy interest in the state for the item of butter alone, and that, too, with comparatively no additional outlay in expense. In this I have not taken into consideration any improvement in quality, either by the methods of manufacture, or by improved pasturage, or other feeding by which a higher price may be obtained, and the revenue correspondingly increased. In this connection it may be of interest to state for your encouragement the comparative yield of this state with other states which are competitors for this product, the dates being obtained from the same source and for the same period: New Hampshire averaged 66 pounds per cow, Massachusetts 56 pounds, Connecticut 67 pounds, Maine 84, Rhode Island 50, New York 79 pounds, Pennsylvania 86 pounds, Ohio 76 pounds, Michigan 93 pounds, Indiana 58 pounds, Illinois 56, Iowa 74 and Wisconsin 72 pounds.

It may be gratifying as a matter of state pride that Vermont out-

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ranks them all, but it does not relieve the lamentable fact that the yield here is far below what it should be. Yet it should serve as an incentive for increased effort to reach a higher standard.

The approaching census may and doubtless will materially change these exhibits. Fortunate will we be if we can still occupy the foreground.

I refer to these subjects and the statistics but briefly, and only by way of illustration. The subject of the agriculture of the great west, and its relation to the products of this state, and its effect upon the markets of the east, is one of primary importance and concern to the eastern farmer. That there exists a strong and powerful competition from this source and that it is to be permanent in its character, no observing man can deny; that the question of sustaining the farming interest of the state on a profitable basis against this competition depends for its solution on the intelligence and skill of the farmers themselves, I think all will admit who will give to the subject a careful and thoughtful study, and the success of the effort will be proportioned to the degree of skill and intelligence which is exercised. It is a comprehensive subject and, did time and the occasion permit, many facts and dates could be given which would greatly interest you, and, to those who have given but slight attention to it, would, I doubt not, be a source of great surprise. I have contented myself to-day with only an imperfect and general reference to it.

Nor is this a suitable occasion to discuss in detail the various methods of improvement in farming, and the results financially which would follow. There is, however, no branch of industry which requires more careful study and more intelligent consideration. Science has devoted to it her deepest researches, and the best minds of the age are occupied in searching out the hidden mysteries of nature, and exploring her laboratories to discover that which is the best food for plants and most successful methods of its application to the soil. To these investigations the country is largely indebted for an awakened interest in the science of farming. But while science is laboring in a wise direction and with beneficial results, the practical farmer, unaided by science, can do much, with the knowledge and material at his hand, to improve his methods of cultivation and to increase the quantity and quality of his stock of manures, and thereby secure an abundant reward for his labor and the rich increase of his harvests. No intelligent man can travel through the agricultural portions of England without being impressed with the thoroughness and perfect method everywhere exhibited in their system of farming. In

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the cultivation of their soils these fundamental principles are uniformly strictly observed; a thorough system of drainage, without which, as an essential prerequisite, no amount of tilling or fertilization would be attempted; a thorough system of cultivation by which the soils should, by proper working and pulverizing, be brought in perfect tilth, and into the most favorable condition for receiving the seed; and a most thorough system of fertilizing, so that at the first germination of the seed it may find proper and abundant food to nourish and quicken its future growth. In the care and management of their stock, the same cardinal principle of thoroughness is everywhere manifested; thorough study and care in the selection of breeds; thoroughness in breeding to success the end sought, whether for the dairy or for the shambles; thoroughness in feeding, and in the selection of the kind and quality of food which will best insure a steadily continued and healthy growth of the animal.

These are the elements and conditions which, as you travel through those rural scenes, which poets have immortalized in verse, and which everywhere excite your admiration and fill the eye with their surpassing beauty and loveliness, you will uniformly observe, and which, with exceptional years, always bring their reward in rich and most satisfactory results.

But alas for the peasantry of England! Neither the favoring conditions of climate, nor the perfected system of husbandry there brought to the highest standards, avail to secure prosperity or independence. The fearful burden of the rent roll, demanded by the rich and titled lords of the soil, the exactions for the support of the clergy and royalty, leave to the poor farmer, as a rule, but a scanty means of subsistence, and in disastrous years like the present, bring distress and the hungry wolf to his very door. Happy are you, my friends, here in your pleasant homes, the title to which is yours indefeasibly, except at your own volition, where, when the wearisome labors of the day are over, you may, with your home treasures of wife and children, gather round your firesides, the lords of your own soil, to enjoy the profits of your labor freed from the burdens of oppressions of exacting landlords, whose luxurious and wasteful extravagance is supported at the expense, and toil, and suffering of their poor and dependent tenantry.

The same method and system which has elevated the agriculture of England to so high a plane, patiently and persistently applied here to the husbandry of Vermont, and the change from an unprofitable or doubtful, to a bountiful and remunerative system, will be fully realized.

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Let me then, my friends, as you are entering once more upon an era of prosperity, urge upon you the need, more than ever before, of a more careful and intelligent study of the great and fundamental principles which underlie all successful farming. Let it be your aim to make each acre of your land, whether in pasture or meadow, or under the plow, produce to its utmost capacity; be satisfied with nothing less than the highest standard of attainment. Drain thoroughly; cultivate thoroughly; fertilize thoroughly. In the management of your dairy, that most important staple of Vermont, let it be your study to produce nothing less than the best. In the methods of manufacture, in the selection and care of your herds, obtain only the most approved. See to it that neither expense in feeding and labor in keeping are wasted on unproductive, worthless animals. Apply those simple and certain tests to the milk of your cows which will soon demonstrate to you what are productive and remunerative and what are unprofitable and worse than worthless Retain in your herds only those that will yield fully up to the standard average both in quantity and quality.

By judicious care and skillful management in these regards you may defy the competition of your great rival. Your garners may be filled to overflowing with the products of your fields. The high pre-emimence which you have hitherto enjoyed for the excellence of your dairy products, may yet be made to reach the more perfect standard; while the rich pastures of your mountain slopes may be clothed with sweeter verdure to delight and fatten your increased flocks and herds. Wealth, sufficient to satisfy your desire, may steadily flow into your coffers, and peace, and plenty, and prosperity everywhere prevail throughout the commonwealth.

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HOME INFLUENCE AND HOME TRAINING.

By Mrs. SHELDON BORIGHT, Richford.

This age in which we live is one of novelty; new plans, new discoveries, new truths, new opinions, whether true or false. Many of them, doubtless, emanating from great minds, are improvements; while others are stepping backward from the practices and habits of our fathers and mothers.

In the arts and sciences, and all intellectual pursuits, rapid strides are being taken in advance. But in the moral and physical training of our youth are we not retrograding from an earlier standpoint of perfection?

The home is, and always has been, the school where the young are drilled and educated (if they are educated at all) for the duties of after life. Home influence is the powerful lever which moves the universe. Every reasoning mind must and does see this. Then how important that our homes be well-regulated, Christian homes. What a blessing it proves to those who have enjoyed homes of love and peace; homes where divine blessing is daily invoked, and every act of life is fashioned after the will of God.

Such a home is the seminary where the faculties are called into active exercise; the best feelings of the heart kept in full and healthful play, giving the purposes and principles a right direction, strengthened for the great battle of life. Would that parents of a household could be made to feel and comprehend the awful responsibility of that announcement, "To us a child is given," a being dependent for life's pilgrimage and eternal destination upon their good or evil training.

Awful reflection! but seldom realized. And when forced on the mind soon dismissed with the thoughtless comment, "Well, I'll do the best I can." Oh, careless parent, do you, as a rule, keep that promise? No, judging from the present misrule in families, love and order are no longer the household duties, but discord and rebellion often drive peace and happiness from the hearthstone.

One whom I believe to be now among the angels once said to me, "Sister, all my success so far in my career is wholly attributable to my early home life. I have had fierce conflicts with sin; but some-

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times when temptation had almost gained the mastery the memory of my father's prayers or mother's sad, reproving eye has enabled right to gain the victory."

The existing evil throughout our country of youthful insubordination against all healthful authority is universally felt by parents, guardians and teachers. Very many of our youth seem to have an antagonistical feeling aroused the instant any restraint is brought to bear upon them.

The great want of deference to elders is remarked on by intelligent foreigners visiting our shores, and frequently unjustly attributed to our republican institutions. It is alleged by these superficial observers that the children drink in with their first nourishment the very spirit of rebellion.

That domestic disobedience does exist to a fearful extent, in the homes of wealth as well as the abode of want, cannot be denied. The plague-spot is in our midst and, unless checked in its progress, will over-spread our loved land and infect our whole moral atmosphere. We trust the future will remove this reproach, for it need not necessarily be so.

Give a child the habit of sacredly regarding the truth; of carefully respecting the property of others; of scrupulously abstaining from all acts which can involve him, or others, in distress, and the child will just as likely think of rushing into an element in which he cannot breathe as lying, cheating or stealing. Add to these that all-important habit of prayerful Bible-reading and a profound reverence for all God's laws.

Let the parents' lives be above reproach, and although they cannot always choose the niche in society for their child, they must, as far as possible, fit them for all by strengthening their moral nature. With the strong steady light of conscience ever shining on his path, habit will smooth and level all the difficulties which may arise.

When a child has been thus fortified by judicious Christian parents they may trustingly confide him to the world's great warfare, knowing that the cloud will shield him by day, the pillar of light guide him by night; and when worn and weary, as he often will be in his pilgrimage, he will turn to that home as a haven of rest where, if hallowed by duty and affection, it will prove as "Bethesda," in which the angel of affection has dipped his wings; there he bathes and is healed. Although bruised in spirit by the cares and perplexities of life, he is refreshed and thus renewed, and in after occurrences in life he will ask but one question, Which is the more worthy and honorable part?

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This training members of society is a fearful responsibility; and the parent who conscientiously fulfills these home duties has many cares. But having once assumed the task, there is no shrinking from the post; for it is necessary in the morning to prepare the soil and sow the seed, and in the evening to do likewise; as they know not which may prosper, this, or that, or whether they shall alike be good. In this the co-operation of both parents is required. This is the only way right home influence can be obtained. Father and mother must work in unison, with perfect confidence existing between them, perfect harmony in every thought and enterprise.

If this is not done, one may be faithful to the trust and by strict care and watchfulness have ready the soil and sow good seeds, but if not aided, or tares be scattered by the other, then will they alike flourish together, and the tares be likely to choke the wheat. It is a deplorable fact that too often are the duties of training our children divided up between father and mother, each one working independently of the other, unheeding the command, "Bear ye one another's burdens." And allow me to say in this division of home labor, home culture, and home training the mother's share is disproportionately large.

Perhaps this is the reason why, in so many instances, her influence over the child so far overbalances the father's. It is as notorious as it is unfortunate that the mother's is almost the only influence to which even boys are subjected. The father loves his boy; is proud of all that he sees in him that is good or noble; he glories in the thought that he has some one to inherit his name and wealth, and exerts every energy of mind and body that he may lay up for him treasures on the earth; but when he sees him straying from the path of rectitude and virtue treats him to an overdose of censure and rebuke, judging hastily and executing judgment harshly, casting, perhaps, a frowning reproach on the patient, over-taxed and grieving mother because she has allowed these errors in his character to exist.

Oh, if fathers would only learn to be just what they would have their sons be; accompanying precept by example; not substitute words for deeds, shadows for substances, like the unwise father I once heard in strong language censuring his son for smoking, while at the same time he was holding a dirty pipe in his own mouth, and cursing him for occasionally indulging his natural appetite for strong drink, while fresh in that boy's memory was the picture of his father staggering home to abuse innocent wife and children in his drunken fury. Have a care, fathers! See that your own lives are pure be-

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fore God and your fellow men, that you may lead your child in virtue's ways instead of pointing out the direction and trying to send him in paths your feet are not accustomed to tread.

It is conceded by profound reasoners that the most powerful of all moral influences is the maternal. A preacher of the gospel said to me recently, "Next to my God do I reverence my mother. My father was a just man, and required implicit, blind obedience. But my mother—God bless her memory—led me in paths of truth and right because they *were* right. All that I am that is true and manly I owe, under God, to my mother."

Such is the influence from the mysterious workings of a mother's heart. On the maternal character depends the mind, the prejudices, the virtues of nations.

What is a child in relation to its mother? An immortal being whose soul it is her business to train for immortality. And that mother who neglects this, or leaves the task (it should be a pastime) for others to perform, may see her child lost in the wanderings of error; or, what is more deplorable, in utter indifference to virtue. Who better than a mother can teach that it is better to prefer honor to riches; to love our neighbor; to exalt the mind to the only source of goodness?

A common tutor requires us to commit to memory, but a mother engraves on our hearts. Oh, mothers, take care! This is our life-work. Let us see to it that it is well done, and when the responsibility looms up before us like towering mountains we will lay all at the feet of Him who has said, He will never leave or forsake us.

Napoleon was once asked, "What is wanting in order that the youth of France be well educated?" The answer was, "*Mothers.* Here," said the emperor, "is a system of education in one word." Let us train up mothers who shall know how to educate their children.

Mothers are apt to forget that not to advance is to retrograde, and most give up, in early married life, all continuance of intellectual cultivation. They forget that though mothers of infants now, they will be mothers of men and women by-and-by. How important, then, that their intellectual growth should keep pace with the growth of those intrusted to their care.

A young mother was once asked by an injudicious friend, "Are you not sorry that you spent so much time and money and hard labor in gaining an education? Marrying so young, you will have no opportunity of using it profitably." What a question! That mother in after years, in the training of sons and daughters, found

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never-ending opportunities of profitably spending the riches of her hard-earned education.

Let women leave the vexed question of "Woman's rights" and turn to their firesides and drive from our midst those worse thralldoms, vice, intemperance, excesses in living, and youthful rebellion, whose chains are being riveted on us; look to the interest of the rising generation by regulating their own households. She who makes her husband and children happy and prosperous shall receive her reward. Her children shall arise up and call her blessed; her husband, also, and he praiseth her. Let us be awake to our duties and guard well the domestic hearth, not forgetting "The child is the father of the man."

With all our boasted prosperity, with all the inexhaustible resources we claim for our immense and extending country, does the human soul grow and prosper here? The glory of a country does not consist in the numbers, but the character, of its population. Of all the fine arts the art of forming noble specimens of humanity is the greatest.

Train up a child in the way he should go, and when he is old he will not depart from it. A difficulty arises to find schools in which the moral and religious training of our boys is not left at an awful distance behind the intellectual. The origin of this error is involved in obscurity. The regulation of temper, the repression of selfishness, the examination of motives, how seldom do they form any part of the school-training of boys. We may see it illustrated in the curious but popular theory which allows a man, by his unregulated temper, to be the torment at times of all who are thrown in his way and yet retain the name of being "a thoroughly good-hearted fellow." How far the good heart brings forth good fruit may be read in the anxious look of the timid wife and the unchildlike manners of frightened children (when father is out of humor.)

A woman with such a temper is deservedly called a vixen. But a man is a good-hearted fellow (only a little hasty, sometimes, when things don't go right).

Oh, why are parents in such haste to transfer to others the delightful task providence has assigned them by so early sending their children to public schools? Do they hope to lessen their weight of responsibility? Vain hope! They, as the guardian angels of their children, are charged with a glorious mission. To them is committed the planting that heavenly germ to which God must indeed give the

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increase, but for the early culture they are answerable. Moral contagion is more dangerous than physical. The one only destroys the body while the other ruins the soul.

Thus far only the moral and intellectual training of our youth has been mentioned; but there is another evil of great proportion, the consequences of which will be fearful on the next generation—the training our youth to habits of idleness. How painful and disgusting in these modern days to see the young ladies of the family lounging in full fashionable costume, reading senseless novels, or absorbed in other frivolous pursuits, unfitting themselves for all the duties of life. While the mother is the household drudge, wearing out the remnant of her days in endeavoring to preserve the daughters' hands spotless, those daughters, instead of assisting in household duties (now deemed so vulgar by the aspiring young ladies of fashion) and lightening the labors of her who gave them life, they are absorbed in the most frivolous pursuits.

The destiny of our daughters is not a trifling destiny; their mission is not a trifling mission; the influence they possess and exercise is not a trifling influence. Ought they then to be trained triflers? Ought their education and pursuits embrace only a round of elegant trifles? In no country where Christianity has placed woman in her proper position, are domestic avocations considered unladylike but in our own. Why is it so many of our young ladies as soon as they take the responsibility of wives and housekeepers, become disheartened, gloomy, fretful, losing the freshness, bloom and vigor of youth as if by magic? 'Tis because from early habit they are so unfitted for life's cares. They break down beneath the burden and become prematurely old. Nor are our young men any better fitted for the mysterious future. Fathers are as deficient as mothers, and many times more careless, allowing their sons to grow up without any fixed occupation or trade. Knowing that idleness is the parent of evil, and an idle person a positive nuisance to themselves and others, we should shun them as lepers. No demand of business exonerates a man from at least evincing that interest in his son which shall fit for, and establish him in some useful occupation. The dwellers in cities and even in villages, are to some extent excusable if this is neglected. For if their sons are not by nature adapted to pursuits within their reach, they often lack the means of supplying employment adapted to the tastes and wishes of their sons.

But the farmer has a source of industry and pleasure united. Who is not made better by active exercise in the refreshing fields and

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pure atmosphere of the farm? The muscles are strengthened, the mind and heart expanded, by communings with nature; while the sun-burnt cheek, the healthy, sparkling eye and brown hands speak of honest, ennobling labor. Parents may think it of small importance, the biasing a young boy's mind in favor of any particular occupation; but it is all-important. Without any fixed ideas of usefulness, he will grow up in idleness, while otherwise he would make a useful member of society. Great results are often the fruits of seeds planted in the little mind.

"A pebble in the streamlet cast,
Has turned the course of many a river;
A dew-drop on the baby plant,
Has warped the giant oak forever."

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FIELD EXPERIMENTS WITH FERTILIZERS,

UNDER THE SUPERINTENDENCE OF THE UNIVERSITY OF VERMONT AND STATE AGRICULTURAL COLLEGE.

By Prof. W. O. ATWATER, Middletown, Conn.

In the following articles, Prof. W. O. Atwater aims to draw from the field experiments superintended by the universlty, some lessons on the value and use of commercial fertilizers in Vermont. It is hoped that many farmers will find herein answers to questions which they are asking. Questions on which further information is desired may be addressed to me, and answer will be made either in future articles or by private communication.

M. H. Buckham, President.

Burlington, April, 1880.

NO. I.

INTRODUCTORY.

During the past two years the state agricultural college, in co-operation with a large number of prominent farmers in the state, has been endeavoring to get some definite information as to the best means of restoring the fertility of our worn-out lands.

The chief reliance of the farmer for bringing up his land and maintaining and increasing its fertility must be proper tillage and economical husbanding and use of the manures of the farm. But most farms do not and many, for some time to come, at least, cannot supply enough of these. In consequence, our farmers are using every year hundreds of thousands of dollars' worth of artificial fertilizers, phosphates, bone, guano, potash salts and the like, and with varying, though, on the whole, favorable results. It is certain that these, rightly employed, are very profitable and often indispensable aids to successful farming.

HOW CAN VERMONT FARMERS USE COMMERCIAL FERTILIZERS PROFITABLY?

To get some light upon this question, and at the same time to learn more of how some of our crops may best be grown, the college

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has instituted experiments with fertilizers in all parts of the state, furnishing materials and directions to intelligent and public-spirited gentlemen who have been making the trials upon their farms. It is proposed to give herewith some of the main results and ways in which Vermont farmers may use them this coming season. Before describing the experiments, however, let us briefly recapitulate some of the

FUNDAMENTAL PRINCIPLES OF PLANT GROWTH AND FERTILIZATION.

1. Plants, like animals, require food for life and growth. A part of the food of plants is supplied from the atmosphere, the remainder is derived from the soil. No ordinary cultivated plant can thrive without a sufficient supply of each of a number of substances needed for its food. With an abundance of all these, in forms in which the plant can use them, and with other circumstances favorable, the crop will flourish. But if the available supply of any one of them be too small, a light yield is inevitable. For instance, *potash* is an *essential ingredient* of the food of plants. If all the other conditions for a good growth of corn, potatoes, or other plants are fulfilled in the soil, except that potash is deficient, the crop will inevitably fail. But if the potash be supplied, the yield will be abundant.

2. The most important soil-ingredients of plant food, the ones that the atmosphere can not supply and the soil must, so that the plant can absorb them through its roots, are *potash*, *lime*, *magnesia*, *iron*, *phosphoric acid*, *sulphuric acid*, *chlorine*, and some compound of *nitrogen*. Plants also take silica, soda and some other materials from the soil, but these are needed only in minute quantities or not at all.

3. In removing crops from the soil we take away plant food. This is the chief cause of soil exhaustion. Lack of fertility is commonly due, in large part or entirely, to lack of plant food.

4. Soils vary greatly in their capabilities of supplying food to crops. Different ingredients are deficient in different soils. The chief lack of one may be potash, of another phosphoric acid, of another several ingredients, and so on.

5. Soils fail to furnish enough food to crops, not so much because they have not abundant stores as because the materials are not in available forms. A soil may have thousands of pounds of phosphoric acid within reach of the plant, but locked up in fragments of rock so that the roots can not absorb it and thus the crop will fail for lack of phosphoric acid.

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6. The infertility of many soils is due more to their mechanical condition, their texture, and relations to heat and moisture, than to lack of plant food. Such soils want amendment first and manures afterward. Some soils will give good returns for manuring; others, without irrigation, or amendment by draining, tillage, use of lime, marl, or muck, or otherwise, will not.

FERTILIZERS AND PLANT FOOD.

7. The chief use of fertilizers is to supply plant food which crops need and soils fail to furnish.

8. But the indirect action of fertilizers in improving the mechanical condition of the soil and rendering its stores of plant food available is very often important. Hence cheap materials like lime and plaster are frequently more profitable than manure or artificial fertilizers.

9. Plants vary greatly with respect to their demands for food, their capabilities of gathering the ingredients from soil and air, and the effects of different fertilizers upon their growth. Hence the proper fertilizer in a given case depends upon the crop as well as upon the soil.

10. The only ingredient of plant food which we need to consider in commercial fertilizers are *potash, lime, magnesia, phosphoric acid, sulphuric acid and nitrogen.* Of this list, magnesia is generally abundant in even "worn-out" soils. Sulphuric acid and lime are more often deficient, and hence one reason of the good effect so often observed from the application of lime and plaster. The remaining substances, the *phosphoric acid, nitrogen and potash*, are the most important ingredients of our common commercial fertilizers, because of both their scarcity in the soil and their high cost.

11. The chief use of commercial fertilizers, guano, phosphates, bone, potash salts and special fertilizers prepared by formulæ for different crops, is to supply nitrogen, phosphoric acid and potash.

12. These materials are expensive, but the right ones in the right places are nevertheless very profitable. Some of the materials used in the experiments we have to report have in some cases given a net profit of nearly $100 per acre. But the same fertilizers in other trials have brought little or no return.

13. It is not good economy to pay high prices for materials which our soils themselves may furnish, but it is good economy to supply the lacking ones in the cheapest way. Farmers cannot afford to use commercial fertilizers at random. No more can they afford to have

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their crops fail when a small outlay for the proper fertilizer would bring a bountiful harvest. And it is time that they understood these facts, the reasons and how to make use of them.

14. The only way to find out what our soils want is to study them by careful observation and experiments. Success in farming, as in other business, requires the use of brains.

We are fortunate in having men in Vermont who are able and willing to study these problems rationally and with a good measure of success. The succeeding articles will give some of the results.

NO. II.

EXPERIMENTS WITH CORN.

The table herewith gives results of some of the experiments referred to in the previous article. As there explained, the object of the experiments has been to get more definite information as to what commercial fertilizers Vermont farmers can profitably use.

The principle upon which the are based is briefly this: The chief office of fertilizers is to supply the plant food that our crops need and soils fail to furnish. It is not good economy to pay high prices for materials which the soil may yield in abundance; but it is good economy to supply the lacking ones in the cheapest way. The most important ingredients of our common commercial fertilizers are *phosphoric acid, nitrogen and potash*, because of both their scarcity in the soil and their high cost.

VALUABLE INGREDIENTS OF COMMERCIAL FERTILIZERS.

Certain kinds of fertilizers sold in the markets furnish nitrogen and little or nothing else of much value for plant food. Such are dried blood, meat scraps, sulphate of ammonia and nitrate of soda. Others, as phosphates and superphosphates, owe their effectiveness mainly to their phosphoric acid. Still others contain both nitrogen and phosphoric acid. Such are Peruvian guano, fish guano, bone, and "ammoniated" superphosphates. Peruvian guano and fish supply considerable of both nitrogen and phosphoric acid, while bone and "ammoniated" superphosphates contain a large proportion of phosphoric acid and but little nitrogen. Potash is supplied in the German potash salts, the "muriate of potash," "sulphate of potash," and kainit. The "complete fertilizers" or "special fertilizers" prepared according to formulæ for special crops, as corn, potatoes, turnips, etc., contain all the above ingredients. Farm manures, stable manure, hen manure, etc., supply all the soil-ingredients of plant food. Wood ashes contain all but nitrogen.

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There are many cases in which crops fail because the soil does not supply enough phosphoric acid and where an application of superphosphate or bone dust brings a bountiful harvest. There are likewise many in which potash is especially deficient and potash salt or unleached ashes will supply the need. In some cases nitrogen in nitrate of soda or other form has the desired effect. In others nitrogen and phosphoric acid are needed and Peruvian guano or fish may be used with great profit. In still others a mixture of superphosphate or bone dust and potash salts, supplying phosphoric acid and potash, is the most economical material. Again on some soils and for some crops nothing short of a "complete" fertilizer will suffice. And finally, while most soils respond to the application of manures there are many on which all fertilizers fail.

PLAN OF THE EXPERIMENTS.

Nitrogen, phosphoric acid and potash are the materials which our soils most frequently fail to supply in abundance to our crops. But they are expensive. We cannot afford to use them where they are not wanted, nor can we afford to let our crops fail when an application of one or more would bring a good harvest. We must then try to find the needs of our soils and crops and the materials that will most profitably supply them.

The experiments were arranged to furnish nitrogen, phosphoric acid and potash, one by one, two by two, and all three together. Nitrogen was supplied in nitrate of soda; phosphoric acid (with sulphuric acid and lime) in a high grade superphosphate, dissolved bone black; and potash in muriate of potash. Plaster (containing sulphuric acid and lime as sulphate of lime) and farm manures were also employed. The materials were used on parallel plots of 1-10 or 1-20 acre, in proportions which gave amounts per acre as in the table.

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TABLE NO. 1.

SAMPLES OF EXPERIMENTS WITH CORN.

Total and average produce of shelled corn per acre with different fertilizing materials.

No.	*Experimenter.*	*Year.*	*Soil.*	*Previous Cropping.*	*Weather.*
1.	B. Landon, South Hero	'78..	Clay loam, compact..	Oats	Unfavorable..
2.	" "	'79..	Clay, calcareous	Old meadow..	Cold, dry
3.	E. F. Smith, Tunbridge	'78..	Loam, compact	Corn	Favorable
4.	J. K. Toby, Calais	'78..	Loam	Potatoes	Favorable
5.	Ora Paul, Woodstock	'78..	Light loam	Old meadow..	Favorable
6.	Z. E. Jameson, Irasburgh	'78..	Sandy loam	Old meadow..	Favorable
7.	S. H. Rising, Rupert	'78..	Sandy loam..	Old meadow..	Favorable
8.	J. A. Chedel, Pomfret	'79..	Sandy loam	Old meadow..	Unfavorable..
9.	J. D. Winslow, Pittsford	'79..	Sandy loam	Old meadow..	Favorable

Number of Plots	0	A	B	C	D	E	F	G	H	F M
Kinds and Amounts of Fertilizing Materials Applied per Acre.	No Manure.	Nitrate of Soda, 200 lbs.	Dissolved Bone Black, 300 lbs.	Muriate of Potash, 200 lbs.	Nitrate of Soda, 150 lbs. Dissolved Bone Black, 300 lbs.	Nitrate of Soda, 150 lbs. Muriate of Potash, 200 lbs.	Dis. Bone Black, 300 lbs. Muriate of Potash, 200 lbs.	Nitrate of Soda, 150 lbs. Dis. Bone Black, 300 lbs. Muriate of Potash, 200 lbs.	Plaster, 200 lbs.	Farm Manures.
Valuable Ingredients applied per Acre.		Nitrogen, 32 lbs.	Phos. Acid, 48 lbs.	Potash, 100 lbs.	Nitrogen, 24 lbs. Phos.Acid, 48 lbs.	Nitrogen, 24 lbs. Potash, 100 lbs.	Phos. Acid, 48 lbs. Potash, 100 lbs.	Nitrogen, 24 lbs. Phos.Acid, 48 lbs. Potash, 100 lbs.	Sulphuric Acid and Lime.	All, but in varying amounts.
Cost per Acre*		$7.50	$5.25	$4.50	$10.88	$10.13	$9.75	$15.38	$0.80	var'ble.
Yield per Acre	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.
Experiment No. 1	7.0	17.5	10.3	9.2	16.5	15.0	18.6	13.5	14.4	48.6
" No. 2	19.7	24.2	22.3	11.0	31.3	14.0	27.2	33.4	25.8	18.0
" No. 3	27.5	35.0	35 0	32.5	35.0	32.5	35.0	32.5	27.0	40.0
" No. 4	48.7	58.3	62.6	70.2	68.5	49.9	59.2	70.3	42.6	45.2
" No. 5	64.9	63.5	64.7	64.3	65.9	69.1	69.3	80.6	65.7	76.7
" No. 6	5.0	11.0	8.5	19.5	17.0	28.0	26.0	31.0	15.0	23.5
" No. 7	27.5	51.9	40.0	49.1	47.1	47.4	53.7	40.0	52.6	
" No. 8	25.4	22.0	28.6	37.1	32.3	47.1	33.4	57.5	38.0	55.5
" No. 9	40.9	59.6	42.2	41.1	57.0	60.0	37.0	60.0	37.5	51.4
Average of 53 Exper'ts†	24.3	30.4	35.2	33.3	38.8	36.8	41.8	47.6	29.0	44.6

*At market prices, plus $5.00 per ton for freight.

†Including a number of similar experiments in other states.

EXPLANATION OF TABLE.

Thus plot A in each experiment had nitrate of soda at the rate of 200 pounds with 32 pounds of nitrogen per acre. Plot B had superphosphate at the rate of 300 pounds with 48 pounds of phosphoric acid. Plot C 200 pounds of muriated potash. Plot D 150 pounds of nitrate soda and 300 pounds of superphosphate; and so on, plot G having a "complete chemical fertilizer" which furnished all the ingredients ordinarily deficient in our soils; and the plot F M farm manures of such sorts and amounts as the experimenters chose to use.

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Most of the trials were upon worn-out grass land. The weather was generally favorable, but in some cases so wet or so dry, so warm or so cold, as to materially injure the crop. With these explanations the table will be clear and we need only note a few of the principal

RESULTS OF THE EXPERIMENTS.

In Mr. Landon's experiments, Nos. 1 and 2, none of the fertilizers had any very marked effect. The reason seems to have been bad weather, cold and drouth, though the soil, a compact clay loam, was hardly the most favorable for corn. Mr. Smith, No. 3, had scarcely more encouraging success. He reports favorable weather, and it looks as though the soil was at fault.

In Mr. Toby's experiment, No 4, on the other hand, the ingredients separately are all efficacious, and together, in G, they bring 70 bushels per acre, while the farm manure brings no increase at all. Doubtless that will show its effect hereafter. Mr. Jameson, No. 6, gets no crop of any amount without potash. With it there is, in every case, a moderate increase. Mr. Rising, No. 7, has good results with all the material. Taking cost into account, plaster is by far the most profitable of all Mr. Chedel, No. 8, finds potash useful in every case, but gets the best results with the complete fertilizer. G, Mr. Winslow, No 9, like Mr. Chedel, gets good yield with all, but finds the mixture of superphosphate and potash salt the most profitable.

On the whole the results vary widely with the soils. But these figures alone are not satisfactory without further considerations which will appear hereafter. Meanwhile it may be noted that:

1. The most profitable material in each case is the one that best fits its special needs.

2. The largest average results were obtained with the "complete" chemical fertilizer G, which excelled even the farm manures.

3. The most profitable fertilizer on the average was the mixture of superphosphate and potash salt. As we shall see later, these two materials rightly applied have proved extremely profitable for corn. According to the very emphatic testimony of these experiments, Vermont farmers will find it very much to their advantage to raise corn by the aid of superphosphate or bone dust and muriate of potash.

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TABLE NO. 2.

SAMPLES OF EXPERIMENTS WITH POTATOES, TURNIPS AND OTHER CROPS.

Total and average produce and increase per acre with different fertilizers.

No.	Experimenter.	Year.	Soil.	Previous Cropping.	Weather.
1.	E. M. Snow, Lunenburgh	'79.	Dark loam, loose	Oats	Favorable
2.	C. H. Cole, Lunenburgh	'79.	Dark loam	Oats	Favorable
3.	J. K. Toby, Calais	'78.	Loam, loose	Potatoes	Favorable
4.	Dr. H. A. Cutting, Lunenburgh.	'78.	Light loam	Old meadow.	Unfavorable.
5.	S. H. Rising, Rupert	'79.	Gravelly	Corn	Unfavorable.
6.	J. K. Toby, Calais	'78.	Same field as No. 3.		
7.	Henry Lane, Cornwall	'78.	Clay loam	Onions	
8.	Dr. H. A. Cutting, Lunenburgh.	'78.	Same plots as No. 4, '78		Favorable

Number of Plots	0	A	B	C	D	E	F	G	H	
Kinds and Amounts of Fertilizing Materials Applied per Acre.	No Manure.	Nitrate of Soda, 200 lbs.	Dissolved Bone Black, 300 lbs.	Muriate of Potash 200 lbs.	Nitrate of Soda, 150 lbs. Dissolved Bone Black, 300 lbs.	Nitrate of Soda, 150 lbs. Muriate of Potash, 200 lbs.	Dis. Bone Black, 300 lbs. Muriate of Potash, 200 lbs.	Nitrate of Soda, 150 lbs. Dis. Bone Black, 300 lbs. Muriate of Potash, 200 lbs.	Plaster, 200 lbs.	Farm Manure.
Valuable Ingredients applied per Acre.		Nitrogen, 32 lbs.	Phos. Acid, 48 lbs.	Potash, 100 lbs.	Nitrogen, 24 lbs. Phos. Acid, 48 lbs.	Nitrogen, 24 lbs. Potash, 100 lbs.	Phos. Acid, 48 lbs. Potash, 100 lbs.	Nitrogen, 24 lbs. Phos. Acid, 48 lbs. Potash, 100 lbs.	Sulphuric Acid and Lime.	Complete Fertilizer. Variable.
Cost per Acre*.		*7.50	$5.25	$4.50	$10.88	$10.13	$9.75	15.38	$0.80	var'ble.
Total Yield per Acre	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.
Potatoes, Expt. No. 1.	37	45	136	49	117	44	145	173	41	
Potatoes, Expt. No. 2.	150	180	175	215	220	260	360	370	150	470
Potatoes, Expt. No. 3.	134	127	127	136	154	122	115	138	132	129
Potatoes, Expt. No. 4.	30	40	80	20	100	60	100	140	60	80
Potatoes, Expt. No. 5.	80	105	110	175	94	125	80	145	90	120
Turnips, Expt. No. 6.	516	565	615	583	593	661	656	785	673	580
Sugar Beets. Expt. No. 7.	795.3	1013.3	1174.0	857.3	1116.0	988.3	1090.6	1118.6	960.6	
Oats, Expt. No. 8	15.6	15.3	45.6	10.0	58.7	54.4	28.1	40.0	27.8	26.9
Average Produce.										
Corn, 37 Expts†	21.3	30.1	34.0	38.7	40.0	23.4	41.5	47.9	24.8	43.5
Oats, 2 Expts	19.4	23.6	33.6	17.8	51.8	42.2	30.0	41 8	25.2	26.9
Potatoes, 14 Expts†	75.0	85.7	97.8	109.0	114.9	92.0	134.9	156.6	87.3	131.9
Turnips, 3 Expts	245.0	283.0	301.0	274.0	391.0	288.0	401.0	501.0	312.0	374.0
Average Increase.										
Corn, 37 Expts		8.8	12.7	17.4	18.7	2.1	20.2	26.6	2.5	21.2
Oats, 2 Expts		4.2	9.2	1.6	32.4	22.8	10.6	22.4	5.8	7.5
Potatoes, 14 Expts		10.7	22.9	34.0	39.9	17.0	59.9	81.6	12.3	56.9
Turnips, 3 Expts		38.0	146.0	29.0	146.0	43.0	156.0	256.	67.0	129.0
Sugar Beets, 1 Expt.		218.0	378.7	56.0	320.7	193.0	294.3	323.30	164.8	

*At market prices, plus $5.00 per ton for freight.

†Including all in which farm manures were used.

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NO III.

EXPERIMENTS WITH POTATOES, ETC.

The accompanying table gives:

1st. Results of several experiments with potatoes, turnips, sugar beets and oats.

2d. A general summary of results of experiments, including those made under the same general plan in other states.*

EXPERIMENTS WITH POTATOES.

In Mr. Snow's experiment, No. 1, every plot which had superphosphate gave a fair yield, every one without it failed. The chief need of that soil seems to have been phosphoric acid. In Mr. Cole's experiment, No. 2, all the materials are useful. The nitrate of soda increases the crop (over that without manure) by 30 bushels, the superphosphate by 25 bushels and the potash salt 65 bushels. Together they are more effective than singly. The complete fertilizer "G" raises the yield from 150 unmanured, to 370 bushels, while the mixture of superphosphate and potash salts brings 360 bushels, a net increase of 220 bushels per acre with a fertilizer costing $9.75 or less. But the largest yield of all was with stable manure, 9 cords per acre, 470 bushels. But while the fertilizers do so well on Mr. Cole's land, Mr. Toby. No. 3, finds no benefit from any of them. Dr. Cutting, No. 4, and Mr. Rising, No. 5. get fair returns, both finding, as is generally the case, that the "complete" chemical fertilizer excels the farm manures. The experiments of Messrs. Toby, Lane and Cutting with turnips, sugar beets and oats need no comment here. Among the more important

GENERAL CONCLUSIONS

to be derived from the experiments are the following: The first as to soils, though stated in a former article, will bear repetition:

1. Soils vary widely in their capacities for supplying crops with food and consequently in their demands for fertilizers.

2. Some soils will give profitable returns for manuring, others without irrigation, drainage, tillage or other amendment will not.

3. The right materials in the right places bring large profits. Artificial fertilizers rightly used must prove most efficient means for restoring the worn-out soils of Vermont. But farmers can not afford to use them at random.

*Under the auspices of the *American Agriculturist*, through whose courtesy the figures have been furnished.

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4. The only way to learn what a soil needs is to study it by observation and experiment.

THE EFFECTS OF THE DIFFERENT FERTILIZERS

as shown by the individual experiments and the general averages in the table are worthy of careful study.

5. It must be remembered that the trials were not only subject to all the vicissitudes of weather and season, but were made on soils of all sorts, but mostly very much run down. The directions were to select worn-out soils. Hence the average results with a given crop do not fairly represent what might be expected on soils adapted to its growth and in average condition.

6. The "Complete Chemical Fertilizer," the mixture of 300 pounds superphosphate, 150 to 200 pounds potash salt, and 150 pounds nitrate of soda, "G," costing $15.38 per acre (including $5 per acre for freight), brought the largest crops. It must be remembered, however, that this mixture was proposed to test soils and not to bring large yields, and does not show how well chemical fertilizers may do. The "complete fertilizers" prepared by reliable dealers for special crops are of course more appropriate for them and would give better results than this mixture.

7. "F." The mixture of superphosphate and potash salt, costing $9.25 per acre, brought a trifle less corn and decidedly more potatoes than farm manures.

8. The mixture of nitrate of soda and superphosphate, "D," which corresponds closest of all to the ordinary ammoniated superphosphates, fish manures and guano, though costing more than the mixture of superphosphate and potash salt, brought less increase of corn, potatoes, turnips, sweet potatoes, and indeed of every crop but oats. The number of experiments with oats, however, is too small for any general conclusions. It is very probable that they and the cereals generally would be more helped by nitrogen, and less by potash, than the other crops. The mixture of nitrate of soda and potash salt, "E," was the least efficient of all.

9. As to the efficiency of the materials separately, the nitrate of soda by itself was seldom of much use, the sulphate of lime was frequently, the muriate of potash very often, and the superphosphate generally profitable. Doubtless considerable of the effect of the superphosphate was due in many cases to its sulphuric acid and lime.

10. The results with ashes (see full report) are variable, though generally they were efficacious.

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ARTIFICIAL FERTILIZERS VS. FARM MANURES.

11. As appears from the figures in the table the "complete chemical fertilizer brought a larger and the mixture of superphosphate and potash salt about the same average increase as the farm manures, taking these as actually used. The quality of the produce was generally as good or even better with the chemicals than with the farm manures. Potatoes, especially, were finer in quality and less disposed to rot with the artificial fertilizers than with the farm manures. To counterbalance the better produce with the chemicals and their greater convenience in handling and applying, the farm manures have the advantage of being in general more lasting in their effects.

12. From results for details of which there is not room here, it would seem that an excellent and, perhaps, for most farmers, the best way to use chemical fertilizers is to supplement a light dressing of farm manure. The results from thus using the two together have been very satisfactory.

13. The proper way is to make the most and best manure possible upon the farm and piece out with such materials as experience and experiment show to be profitable.

METHODS OF APPLYING THE FERTILIZERS.

As between applying artificial fertilizers broadcast or in the hill or drill, the testimony of the experiments is, on the whole, in favor of the former. The best results in the majority of cases came where the fertilizers were sown broadcast. In some of the very best the materials were scattered over a strip a couple of feet or so wide along the rows. Such concentrated materials when too close to the seed are apt to injure the plant, especially in dry weather. The nitrate of soda and muriate of potash often do harm in this way.

NO. IV.

The results of the experiments will of course be more valuable when taken in connection with the composition and cost of the fertilizers in the markets and the teachings of science and experience as to their use. Since the chief use of commercial fertilizers is to supply plant food, the rule should be to select those materials which supply, in the best form and at the lowest cost, the plant food which the crop needs and the soil fails to furnish. The ingredients of plant food most lacking in our soils are phosphoric acid, nitrogen and potash, and less frequently, sulphuric acid and lime. Of the

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commercial fertilizers which Vermont farmers will do best to buy to supply these substances (aside from plaster, which furnishes sulphuric acid and lime and helps the growth of crops in other ways also), the following are among the most important.

PARTIAL FERTILIZERS.

For phosphoric acid (with sulphuric acid and lime), superphosphates, i. e., dissolved bone black and mineral superphosphates.

For phosphoric acid with a little nitrogen, "nitrogenous" or "ammoniated" superphosphates and ground bone.

For nitrogen and phosphoric acid (both in considerable quantities), Peruvian guano and fish guano.

For potash, German potash, salts of the various grades, of which the "muriate," with 50 per cent or more of actual potash, is generally preferable.

The following details will be useful to purchasers:

1. Superphosphates proper, otherwise called "acid phosphates." The chief value of these rests in their phosphoric acid. They are made by treating bone black (charred bone), Canada apatite, and South Carolina, Navassa and other fossil and mineral phosphates, with sulphuric acid, which renders their phosphoric acid soluble and hence available to plants. Besides phosphoric acid they contain sulphuric acid, lime and other ingredients of less or no value. "Dissolved bone black" and other superphosphates of this class, with from 14 to 16 per cent of soluble phosphoric acid, are sold in the Boston and New York markets for $30 to $35 per ton, and furnish soluble phosphoric acid at 10 to 12 cents per pound.

2. Nitrogenous superphosphates.—Most of the so-called superphosphates in the markets, the "ammoniated" and "nitrogenous" superphosphates and "guanos," other than "fish guano" and true Peruvian guano, are prepared by mixing superphosphates proper, of higher or lower grades, with some material to supply nitrogen, like dried blood, meat scraps and fish scraps. These mixtures have the advantage over the superphosphates proper, that their nitrogen is very valuable and often essential, and the disadvantages that they supply less phosphoric acid and that their valuable fertilizing ingredients are more costly than in the unmixed materials. They generally contain from 8 to 15 per cent of phosphoric acid, of which from half to nearly all is available (soluble and "reverted") and 1½ to 4 per cent of nitrogen. They are retailed at from $40 to $50 per ton, which brings soluble phosphoric acid at 11 to 18 cents and nitrogen at 20 to 30 cents per pound.

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3. Ground bone.—Pure ground bone contains usually from 20 to 26 per cent of phosphoric acid and from 3¼ to 3¾ per cent of nitrogen. It may be bought at from $30 to $35 per ton, the phosphoric acid thus costing 5 to 6 cents and the nitrogen 10 to 12 cents per pound. As compared with superphosphates, bone has the disadvantage of being very slow in its action unless ground to a very fine powder; and the advantage that it furnishes more of the available ingredients at lower rates and that it is more lasting.

4. Peruvian guano.—Of the various grades the "standard 10 per cent ammonia" is one of the best. This contains about 8½ per cent of nitrogen (equivalent to 10 per cent ammonia), 14 to 16 per cent phosphoric acid and 3 to 4 per cent of potash, and retails in Boston and New York at $50 per ton. The nitrogen thus costs about 16 cents, the phosphoric acid, soluble, 11 cents, and reverted 7½ cents, and potash 6 cents per pound. Peruvian guano is a concentrated, quick-acting fertilizer; its ingredients are in readily available forms. Taking into account quality and price, it is one of the cheapest fertilizers in the market.

5. Fish guano and fish scraps are prepared from the refuse "pomace," left after extracting the oil from fish. The scrap which is coarse is much used along the coast. The dried and ground "fish guano" contains usually some 7 to 8 per cent of phosphoric acid and 8 per cent of nitrogen, and at $40 to $45 per ton supplies phosphoric acid at 7 to 8½ cents, and nitrogen at 18 to 22 cents per pound. Dry ground fish is a quick-acting fertilizer and an economical source of nitrogen and phosphoric acid.

6. Nitrogen, sulphate of ammonia, nitrate of soda, dried blood.—Nitrate of soda is at present very high. Sulphate of ammonia, with 25 per cent of ammonia, equivalent to 20½ per cent of nitrogen, is quoted at $85 per ton, which brings nitrogen at about 20 cents per pound. It is a very concentrated, quick-acting fertilizer and very good for farmers to buy as a source of nitrogen. Some specimens contain less than 25 per cent ammonia and should be sold at corresponding rates. Dried blood varies in nitrogen, usually from 8 to 11 per cent, and in price from $40 to $45 per ton. An article with 10 per cent nitrogen (12½ per cent ammonia) at $40 would supply nitrogen at 20 cents per pound.

7. Potash salts.—Aside from unleached ashes, the best source of potash is in the German potash salts, of which there are three principal sorts in our markets—sulphates, muriates and kainit. The sulphates are the most expensive and are difficult to obtain pure. The muriates, with 80 per cent of chloride of potassium or more,

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corresponding to 50 per cent or over of actual potash, is sold at about $40 per ton, furnishes potash at 4 cents per pound, and is to be highly recommended. Some prefer the sulphate for potatoes, on the ground that it is said to have a better effect on the quality. But this is hardly proven as a rule. In the experiments the muriate has brought excellent potatoes, and considering the less cost and greater reliability of the muriate, it is doubtless preferable for Vermont farmers. The kainit is a low grade material containing a great deal of common salt, and only from 9 to 14 per cent of potash.

"COMPLETE" FERTILIZERS—FORMULÆ FOR SPECIAL CROPS.

The "special" fertilizers for corn, potatoes, turnips, grass and other crops, supply nitrogen, phosphoric acid and potash in such amounts as each particular maker chooses. They have the advantage over superphosphates, bone, potash salts and other incomplete fertilizers, that they furnish all the ingredients commonly deficient in our soils, and in proportions more or less accurately fitted to the wants of the crops; and the disadvantages are that they are expensive and contain materials which may or may not be needed and effective. There are many cases in which complete fertilizers are in place and many others in which a farmer can better afford to pay for unnecessary ingredients than to risk the loss of his crop. But Vermont farmers, who are situated at a distance from market and must pay well for their fertilizers without getting the highest prices for their produce, will do best to learn by experiment and experience what materials best serve their needs, and purchase accordingly.

NO. V.

WHEN AND WHERE TO USE THESE FERTILIZERS.

As our experiments, general experience and sound science show, soils, crops and other conditions differ, and each man must study his own. Nevertheless there are some general facts that help in deciding what fertilizers are best.

FERTILIZERS FOR CORN.

In the experiments with corn, nitrogen was rarely, the potash salt often, and superphosphate generally profitable, where soil and season were such as to permit good growth with any manure. On the average, the most profitable mixture used for corn has been 300 pounds of superphosphate (dissolved bone black or other mineral

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superphosphate) and 150 pounds of muriate of potash. At $35 per ton for superphosphate, and $40 per ton for the muriate, this would come to $8.25, to which must be added cost of freight and applying. In the average of a number of special experiments (not described in the previous articles) this has brought 50½ bushels of shelled corn. Addition of nitrogen has increased the yield somewhat, but generally not enough to pay the cost. A mixture of 150 to 200 pounds of muriate of potash and 300 to 400 pounds of fine bone dust has also given excellent results with corn.

Unless the unanimous testimony of the experiments is false, Vermont farmers can add greatly to the fertility of their fields and the profits of their farming if instead of buying western corn they will raise it, with such helps as we shall hereafter take occasion to explain in more detail.

FERTILIZERS FOR POTATOES AND TURNIPS.

Potatoes have responded well to all the ingredients, nitrogen, phosphoric acid and potash. The complete fertilizers have been the most profitable in nearly all the cases where soil and weather were not too adverse. The mixture of 300 pounds superphosphate, 200 pounds muriate of potash, and 150 pounds nitrate of soda, costing about $15.50, has brought an average yield of 160 bushels, and in some cases over 300 bushels, about double the product without manure. Nitrogen could be furnished more cheaply in sulphate of ammonia or dried blood, than in the nitrate of soda. Peruvian guano would probably be better still to supply nitrogen and phosphoric acid. Fish would serve the same purpose.

The experiments with turnips have shown the best results with the complete fertilizer, though they responded well to the superphosphate in every case. They are as yet too few, however, for reliable inferences. Still they accord with the common impression that makes phosphoric acid, in the form of superphosphate and bone dust, almost a specific for turnips.

FERTILIZERS FOR GRAIN AND GRASS CROPS.

For wheat, oats, rye and barley, general experience favors nitrogen and phosphoric acid, though potash is frequently profitable. Peruvian guano, fish bone, superphosphates and sometimes potash salts are apt to be profitable. For grass land, bone, superphosphates and often potash salts are found useful. Clover is especially benefited by potash, and gets little good from nitrogen. Sometimes a nitrogenous fertilizer like sulphate of ammonia is excellent

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as a top-dressing in spring, to force a backward crop of grass or grain. The old pastures and meadows of our dairy farms are very commonly deficient in phosphates. Bone supplies this lack cheaply. It is slow and lasting in its action and hence particularly good for seeding down to grass.

QUANTITIES OF COMMERCIAL FERTILIZERS TO USE.

The amount that can be profitably used varies, of course, with circumstances. From 100 to 250 pounds of a potash salt, 250 to 400 pounds of superphosphate, 300 to 600 pound of bone dust, 200 to 300 or 400 pounds of Peruvian guano, 150 to 200 pounds of dried blood or nitrate of soda, and 100 to 150 pounds of sulphate of ammonia are moderate dressings per acre. Where several articles are used together, somewhat less of each would naturally be applied than where they are employed separately. When used with farm manures, still smaller quantities suffice. Two hundred pounds of superphosphate, or 100 pounds of muriate of potash, do very well to supplement a dressing of stable manure. Indeed, on farms removed from the larger markets this is usually the best way to employ such costly materials. They furnish plant food ready for immediate use and thus the crop is apt to get a better start, ripen earlier, and be larger than with farm manure alone. A moderate excess of the fertilizer above the demands of the crop does it no harm unless it is concentrated too closely about the roots. The absorptive power of most soils suffices to retain most of the phosphoric acid and potash until they are used by plants, but nitrogen is exposed to more or less rapid loss by being leached away by drainage water, forming inert compounds in the soil, or escaping into the air. If the phosphates and potash salts, therefore, are not taken up by the first crop, the soil will usually hold them for succeeding ones, while more or less of the nitrogen will run to waste.

HOW TO APLLY COMMERCIAL FERTILIZERS.

The safest way is to apply broadcast, but they may be put in the hill or drill, *provided they are well diffused through the soil.* This last point is very important.

"Farmers are apt to think the manure must be put close to the seed or the plant will not get the benefit of it. This is wrong. It is not the just germinated plantlet that needs the manure, but the plant, from the time it is well started until its growth is done. We want, not only to give the crop a good start, but to help it out on the home stretch as well. The roots and their branching rootlets

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run out in all directions in search of food, and the fertilizers ought to be where as many of the rootlets as possible can get at them. If we distribute the fertilizers as well as we can, the water in the soil, aided by the chemical and physical forces that nature keeps in operation, will do the rest. In illustration of this, remember how well barn manure acts when applied as a top-dressing long before the seed is put in.

But if we concentrate the fertilizers in one place, fewer roots will get them, and these may be injured by coming in contact with them or with their concentrated solutions in the soil. The roots will find their way to the manure and develop more where it lies, it is true; still we should not oblige them to huddle together in one place, but should rather encourage them to spread around, where, with the increased capacity the fertilizer gives them, they can get the more from the soil. Roots join with other natural agents in rendering inert stores of plant food available.

Above all, do not let the fertilizers come too close to the seed. A coarse, dilute material like yard manure may do the plants no harm, but such concentrated fertilizers as guano, potash salts, dried blood, or high grade superphosphates may kill them.

Some of the best results in the experiments have come where the fertilizers were spread broadcast over a space eighteen inches or two feet wide along the row. If they are to be put in the hill or drill they ought to be *first mixed with three or four times their bulk of mellow earth.* If the latter is rich in vegetable mould, so much the better. Moist sawdust or muck may be used in place of the earth, if more convenient.

ANSWERS TO CORRESPONDENTS.

Mr. D. B. Wheelock, of Barre, has joined with a neighbor in buying sulphate of ammonia, superphosphate and muriate of potash. They inquire:

1. "Is any other chemical needed with these?" Answer, no. These furnish nitrogen, phosphoric acid and potash and make a "complete fertilizer." But unless you have found that your soil wants all of these ingredients you may be using some at a loss.

2. "Shall we apply them separately or mixed?" As is most convenient. Probably labor will be saved by mixing well upon the barn floor before applying. Only if a large amount of the potash salt is to be used it would be well to apply it some weeks or months before the seed is put in, so that it may get well diffused through the soil.

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3. "How much of each shall we use per acre?" As said above, 100 to 150 pounds of sulphate of ammonia, 200 to 400 pounds of superphosphate and 100 to 200 pounds muriate of potash, are fair amounts. Use more if the soil is run down than if it is in good condition, and less of such material when all are applied together than if it were used alone. For grain crops, let nitrogen and phosphoric acid, sulphate of ammonia and superphosphate, predominate; for corn, use phosphoric acid and potash freely, and little if any nitrogen; for potatoes, all three liberally.

4. "Would it be well to mix all with plaster, muck or earth?" Yes, if convenient, especially if you apply in the hill or drill. Plaster is well, if cheap and your experience promises profit. Muck is excellent if well weathered and dry. Otherwise use good mellow earth to dilute the fertilizers.

Mr. Wheelock's plan of clubbing with his neighbor, buying the materials and mixing them, is very sensible. They get them probably for 20 per cent less than they would cost mixed in "complete fertilizers;" by purchasing in large amounts they get some discount, and if they pay cash, still more; and finally, they know what they are about, can mix at discretion, and use with profit.

NO. VI.

SHALL VERMONT FARMERS RAISE MORE CORN?

FERTILIZERS FOR CORN.

It is said that many of even the smaller towns in Vermont expend from $12000 to $18000 annually for western corn. Whether these figures are accurate or not, it is certain that we buy a vast deal of corn and that it would be much to our advantage if we could raise it cheaply at home. With a cheap and effective manure this could be done. But our farms do not furnish manure enough and we have to look outside.

Various artificial fertilizers have been proposed for corn. Mr. Lawes, the famous English experimenter, from results obtained during 30 years of costly experimenting, recommends as "the best possible manure for the cereals," wheat, rye, oats, etc., including corn, "a mixture of nitrate of soda and superphosphate." M. Ville, of France, and Prof. Stockbridge of the Massachusetts agricultural college have proposed formulæ of which the ingredients and costs per acre are as below, the prices being reckoned at current market rates. Ville's formula is fitted to the assumed requirements of the

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crop from the soil, while Prof. Stockbridge's formula furnishes the amounts of nitrogen, phosphoric acid and potash, which he calculates to be contained in a crop of 50 bushels, including corn and stover.

FERTILIZERS FOR CORN.

MR. LAWES.

"Best possible manure," "Mixture or superphosphate and nitrate of soda."

VILLE FORMULA.

Materials per acre.		Ingredients.	COST. In formula.	In cheapest form.
Nitrate of potash,	180 lbs.	Nitrogen, 64 lbs;	$9 20	$4 80
Acid phosphate of lime.		Phos. acid, 81 lbs.,	9 45	9 45
	540 lbs.	Potash, 79 lbs.,	7 00	3 56
Sulphate of lime,	360 lbs.		1 44	1 44
			$27 09	$19 25

STOCKBRIDGE FORMULA.

Materials per acre.		Ingredients.	In formula.	In cheapest form.
Sulph. of ammonia,	320 lbs.	Nitrogen, 64 lbs.,	$15 20	$12 80
Superphosphate,	248 lbs.	Phos. acid, 31 lbs.,	4 34	4 34
Muriate of potash,	154 lbs.	Potash, 77 lbs.,	3 46	3 46
			$23 00	$20 60

Now it is clear that Vermont farmers cannot afford to pay from $19 to $27 for fertilizers for an acre of corn. The experiments previously described show that Mr. Lawes' mixture would frequently fail for lack of potash, and the large quantities of superphosphate and plaster in the Ville would not do for us. In the Stockbridge formula the chief expense is for the nitrogen. The "mineral" ingredients, superphosphate and potash salt, are comparatively inexpensive. Will they serve the purpose without the nitrogen?

The first things to be learned are the power which the plant has to gather its supplies of food from natural sources, and the specific effects of different fertilizing material upon its growth.

THE FEEDING CAPACITIES OF PLANTS.

Leguminous crops, like clover, do, somehow or other, gather a good supply of nitrogen where cereals, such as wheat, barley, rye and oats, would half starve for lack of it, and this in the face of the fact that leguminous plants contain a great deal of nitrogen and cereals relatively little. As a matter of experience it is found that while wheat usually demands and responds to nitrogenous manures,

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clover does well with mineral fertilizers, superphosphates, potash salts, plaster, ashes, etc., and is very little helped by nitrogen. And, what is still more remarkable, the best evidence we have indicates that after a crop of clover with its large amount of nitrogen is taken away, the soil is little or no poorer in nitrogen than it was before the clover grew upon it. Indeed, taking into account the root and stubble, it is richer. Hence clover is known as a "renovating" crop while wheat ranks as an "exhausting" crop. Often the best way to manure the land is to grow clover and turn it under or feed it out and return the manure to the land.

IS CORN AN EXHAUSTING OR A RENOVATING CROP?

Can corn gather its nitrogen from soil and air, like clover, or does it, like wheat, require large quantities in fertilizers? Is it especially helped by phosphoric acid like turnips, or is potash more important to aid its growth? The main question is the nitrogen supply. If farmers who have not enough manure advance from $10 to $15 cash in the spring for nitrogen for an acre of corn, run all the risks of soil and season, and wait until winter for the return, the future of corn-growing is not bright. But if, on the other hand, we may omit the nitrogen, apply only the inexpensive mineral fertilizers, reduce the yield but little, have the corn gather the nitrogen itself, feed it to stock, and thus get rich manure for other crops at low cost, then corn-growing with commercial fertilizers may become one of the most potent agencies for the amelioration of agriculture in Vermont.

EXPERIMENTS BY COL. MEAD OF RANDOLPH.

Our experiments have something to say about this matter. One by Col. J. B. Mead, state superintendent of agricultural affairs, is especially instructive.

The idea was to compare the effects of mineral fertilizers (superphosphate and potash salt) alone and of the same with nitrogen in different amounts and forms. Phosphoric acid was applied in superphosphate at the rate of 300 pounds per acre, potash in muriate of potash, 150 pounds per acre, and nitrogen in nitrate of soda, sulphate of ammonia, dried blood and Peruvian guano, in varying amounts. Phosphoric acid and potash were thus furnished in about the amounts contained in a corn crop of 50 to 60 bushels, and nitrogen in one-third, two-thirds and the full amount in the same crop. There were, in all, sixteen kinds and mixtures of artificial fertilizers on as many plots, while ashes, farm manures and other materials

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were also used and several plots were left unmanured for comparison. The ingredients were applied singly and two by two, and then starting with the mixture of superphosphate and muriate of potash, "mixed minerals." Nitrogen, in various forms and amounts, was added to these on nine succeeding plots, after which came a duplicate plot with "mixed minerals" and then the farm manures. The season was cold, backward, and, on the whole, in Col. Mead's estimation, "the most unfavorable for corn in this section for 20 years." The unmanured plots brought from 7 to 10 bushels of shelled corn per acre. Every plot with potash gave a fair yield, every one without it failed. The muriate, costing by the ton, freight included, $3.38, brought 41¼ bushels; the mixture of this and superphosphate, "mixed minerals," which would cost in Boston or New York, say $8 and in Randolph $9, gave in one case 50¼ and in the other 45⅞ bushels; unleached ashes, 60 bushels per acre, gave 50⅜ bushels; stable manure 46½; hen manure 43¼; and night soil 30⅝ bushels. The effect of nitrogen was unexpected. Comparing the plots that had nitrogen in various amounts and forms added to the mixed mixed minerals with those that had mixed minerals alone, the nitrogen ("complete" fertilizer) plots yielded less in seven cases out of nine, and in the two in which there was an increase with the nitrogen, this was far from sufficient to pay the cost.

The potash salt and the mixture of that and superphosphate, brought good yields in spite of the remarkably cold and backward season. The nitrogen was used at a loss in every case.

RESULTS OF OTHER EXPERIMENTS.

Fortunately Col. Mead's experiment is not the only one of the sort we have to judge from. Like trials in 1878 and 1879, under the auspicies of the New Hampshire and Maine agricultural colleges, and in Connecticut also, have brought results which, though varying in detail, are similar in substance. The average yield with the mixed mineral fertilizers in all these "special corn experiments" amounts to a trifle over 50 bushels of shelled corn per acre.

In the general experiments described in the previous articles, a mixture of 200 pounds muriate of potash and 300 pounds superphosphate brought, on the average of 53 experiments in various states, about 42 bushels of shelled corn per acre. The "special" experiments, however, seem a fairer test of what the fertilizers may do, because while made on Vermont soils and in good seasons and bad, they were on soils and in latitudes fit for corn, while many of the general experiments were not.

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THE OUTCOME OF THE EXPERIMENTS WITH CORN.

Taking all the experiments together, the nitrogen increased the crop enough to pay its cost in 13 trials out of 96. The pecuniary loss rose and fell with the amount of nitrogen used. With the "mineral" fertilizer alone the yield was fair, a trifle less on the average than with farm manures, and the crop gathered from soil and air some 65 pounds of nitrogen per acre, which in ordinary fertilizers would cost from $12 to $15.

As regards the effects of the fertilizing materials separately, the superphosphate was generally, and the muriate of potash often profitable, while nitrogen rarely paid its cost. In bad seasons all the materials, including farm manures, frequently failed and, on some soils, the same was true even when the season was favorable. The most effective material depended upon soil and season.

These experiments imply that corn does not generally get much help from nitrogen in fertilizers; that it has somehow or other the power to gather a pretty fair supply for itself from soil or air, or both, and that in this respect it comes closer to the legumes than the cereals; that it is more like clover than wheat—that, in short, corn may be classed with the "renovating" crops. So weighty a question, however, demands more investigation; at the same time the results already obtained are capable of a very important

PRACTICAL APPLICATION—RAISING CORN TO MAKE MANURE.

The same valuations of digestible food—ingredients that would make a ton of ordinary hay worth $11 and a bushel of shelled corn 60 cents—would bring a ton of well-cured cornstalks at $8. Reckoning the stalks at only $6 per ton, and $1\frac{3}{4}$ tons to the 50 bushels of shelled corn which came with the mixture of 300 pounds of superphosphate and 150 pounds muriate of potash, the value of the crop would be $40.50.

Supposing the crop to be fed out upon the farm, two-thirds of its nitrogen, phosphoric acid and potash, reckoned at prices ordinarily paid for them in equally valuable forms in commercial fertilizers, would be worth $9, the cost of the fertilizer. The fertilized crop probably leaves the land in about as good condition as it was before; the manure, well husbanded, more than pays for the fertilizer, and we have the value of the crop for fodder in return for the rent of an acre of land and the labor of raising the corn.

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IN CONCLUSION.

The dispensation of an all-wise Providence which has made soils and seasons to differ, renders a formula for corn or any other crop irrational. We simply tell the farmers of Vermont what their fellow farmers have been doing, in co-operation with the college, and add that, if these experiments are to be taken as a guide:

1. In the large majority of cases where any manure will bring a good crop of corn, a fair yield may be expected with some such a mixture as the one named, 300 pounds superphosphates, and 150 pounds of muriate of potash.

2. By the aid of this fertilizer the corn gathers a large quantity of nitrogen, which is very important in the fodder and greatly enriches the manure.

SHALL WE BUY OUR CORN OR RAISE IT OURSELVES?

3. Corn produced in this way costs much less than western corn. Fed to stock and made into manure, it does much more to enrich the land, because of the stalks which we do not get with the western corn.

4. Either the unanimous testimony of these experiments by progressive farmers on their farms is wrong, or corn can, by aid of artificial fertilizers, be grown with profit in Vermont.

5. The best evidence at hand implies that, in most cases, the best way is to apply a light dressing of farm manure and supplement with a proper commercial fertilizer, superphosphate or muriate of potash, or both.

6. We suggest to farmers to try corn-growing in these ways. If they will report their experience to the college it will thank them and do its best to make the results known and useful through the state.

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SUGAR FROM CORNSTALKS AND SORGHUM.

AN ABSTRACT OF AN ADDRESS DELIVERED IN THE HOUSE OF REPRESENTATIVES, HARTFORD, CONNECTICUT, TUESDAY EVENING, FEB. 17, 1880.

By PETER COLLIER, Chemist of the Department of Agriculture, Washington, D. C.

Within the past two years a new industry has been established which, in its magnitude and importance, it is almost impossible to estimate. It appears to be fully established that sugar may be obtained economically from the stalks of maize and sorghum, with no more difficulty than attends its production from the sugar cane, and that at no distant future we shall produce from material heretofore regarded as refuse an abundant supply of this almost indispensable requisite of modern life, for our own use not only, but sufficient for the world's demand; and, unless the results thus far secured are wholly exceptional in their character, this new industry promises to work a revolution in our national affairs, and prove to agriculture one of the greatest blessings of the century.

Very few who have not given especial attention to the statistics of the sugar trade are aware of the magnitude of this industry. According to the American Almanac the total product of sugar in the world was, in 1875, as follows:

Cane sugar,	2,140,000 tons.
Beet sugar,	1,317,623 tons.
Total,	3,457,623 tons.

In the United States the importation of sugars since 1848 (the date of the discovery of gold in California) has amounted to an aggregate of $1,750,000,000, and the entire production of all the gold and silver mines of the west since 1848 has amounted to but a fraction more, it being estimated at $1,800,000,000.

In 1877 there was imported into the United States 811,967 tons of sugar, valued at $73,780,829, and upon which the duties were $35,274,468, a total cost of $109,055,297.

The average consumption is from 36 to 40 pounds per annum for every man, woman and child in the United States; and there can be no doubt but that if the cost should be diminished one-half the consumption would easily be doubled.

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Of the total sugar consumed in the United States we import about 87 per cent, and 80 per cent of the molasses consumed. Nearly all of our importation is from Cuba; and, by those to whom moral considerations appeal, it is to be remembered that it goes to sustain an institution—human slavery—which we, thank God, have got rid of in our own country.

Thus far the sugar produced in the United States has been almost entirely from the sugar cane, and this plant being tropical has been cultivated as an exotic in a small area of Louisiana. Requiring as it does fully twelve months for its maturity, it never reaches that condition when its content of sugar is at its maximum, and the sugar industry of Louisiana is pursued in peril each year, lest an early frost should disappoint the hopes of the planter.

Many attempts have been made in Maine, Illinois, Wisconsin and California to introduce the cultivation of sugar beets and the manufacture of sugar therefrom, but in every case thus far these efforts have been failures, and there remains little reason to hope that this beet sugar industry will ever attain success except, perhaps, in a few very favoring localities.

At the present time a beet sugar factory is in operation in Maine, which promises well, and it is certainly to be hoped that they may realize fully their sanguine expectations. But I am informed that even in Germany, in sections where for half a century this industry has been fully established, that even now the profits from the production of beet sugar are derived wholly from the sale of the cattle fattened upon the pulp of the factories. It is well to remember that from the earliest history of this beet sugar industry it has had the fostering care of science, and has been brought up to the highest limit of practical economy in all its details; so that whoever shall hope to succeed must enter upon the business fully equipped with the most improved apparatus, and informed as to every detail of the production.

Lest these statements may appear too disheartening, I would quote from a statement made by L. D. Morse, said to have been the editor of the *Journal of Agriculture*, at St. Louis, Mo., in reference to the beet sugar factories of California: "The total expenditure in the state upon beet sugar factories will probably reach a million of dollars, with results either disastrous or wholly unsatisfactory."

But although limited in our area upon which the sugar cane can be grown with even approximate success; and with little chance of establishing the production of beet sugar upon a profitable basis,

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there yet remain two sources of supply which are practically exhaustless, the stalks of maize and sorghum.

The entire acreage of all the cultivated land of the United States including that in the cereals, root-crops, cotton, and the grass lands equals 132,910,281 acres. Of this area 50,369,113 acres or 38 per cent is in maize. The enormous extent of this cereal becomes thus apparent. The sorghums as a class are plants of a similar habit, requiring similar cultivation and capable of being grown, the one variety or another, wherever mai ze may be successfully grown.

The availability of these plants as a source of sugar has been known for a long time, but although much has been known little appears to have been done in the way of careful investigation for the purpose of determining their practical value for the production of sugar. Indeed many of the statements made in reference to maize appear almost prophetic, and it appears reasonably certain that had the matter been carefully followed up by a series of experiments, the enormous drain upon the country, which, as we have seen, has required all the gold and silver product of the country to supply, might have been prevented not only, but we might have been a half century ago the great sugar producing country of the globe. In a letter from Abigail Adams to her husband, John Adams, September 24, 1777, she says:

"An instance may be seen in the progress which is made in grinding cornstalks and boiling the liquor into molasses. Scarcely a town or parish within forty miles of us but what has several mills at work; and had the experiment been made a month sooner, many thousand barrels would have been made. No less than 80 have been made in the small town of Manchester. It answers very well to distill, and may be boiled down to sugar. There are two mills fitting up in this parish. They have three rollers—one with cogs and two smooth. The stalks are stripped of the leaves and tops, so that it is no robbery upon the cattle, and juice ground out. 'Tis said four barrels of juice will make one of molasses, but in this people differ widely. They have a method of refining it so that it looks as well as the best imported molasses."

David Lee Childs on the culture of the beet and manufacture of beet sugar, says:

"Other plants usually grown in our soil are capable of furnishing sugar, and some of them may be found worth cultivating for that and accessory products.

"We have tried Indian cornstalks and the pumpkin, and have obtained from them good sugar and molasses.

"Perhaps these crops may alternate advantageously with the beet. If the manufacture of sugar from the stalks of Indian corn can be

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reconciled, as we believe it may, with the maturity or near maturity of the ears, this source of saccharine may supersede the beet root."

Under date of March 13, 1880, R. S. Hinman of Hartford, Connecticut, writes me as follows:

"I have found that in 1717 one of my ancestors procured a patent from the general court of the colony of Connecticut to make molasses from cornstalks on condition that he should make it as good and as cheap as it could be got from the West Indies."

At a meeting of the French Academy, M. Biot stated that he had found 12 per cent sugar in juice from cornstalks in one experiment, 13 per cent in another. In the Farmers' Encyclopedia is the following: "The juice of maize contains as much if not a larger proportion of sugar than that of sugar cane."

In Porcher's "Resources of Southern Fields and Forests," he says:

"In the first place it has been satisfactorily proved that sugar of an excellent quality, suitable for common use without refining, may be made from the stalks of maize." Again: "The sweetness of the cornstalk is a matter of universal observation. Our forefathers, in the Revolutionary struggle, resorted to it as a means to furnish a substitute for West India sugar."

Thaër, in his "Principles of Agriculture," (1844) says:

"The use of unripe maize for the manufacture of sugar has lately been again recommended on the ground that maize is better adapted for this purpose than beet root. I have long been of the opinion (he adds) that of all plants which can be raised in this country, maize is best suited to the purpose in question; the syrup extracted from it is, before crystallization, decidedly superior to that of beet root."

I have been recently informed that, over thirty years ago, there was a factory in the south of France, which produced large quantities of excellent sugar from the stalks of maize, but the rapid development of the beet sugar industry caused this factory to decline, and their practical results appear to have been almost forgotten. I also learn that about 1844, a certain judge, of Williston, Vermont, produced a fair quality of syrup from cornstalks, but his experiments, like those of so many others, caused only a temporary and local excitement, which speedily died away.

The same is true as regards the sorghums. These plants were first grown in this country from seed obtained from Paris in 1856. About this time, or perhaps a year later, Mr. Leonard Wray introduced the seed of sixteen varieties of sorghum from Africa. These varieties received the general name of Imphees, while the first varieties introduced were from China, and were known as Chinese sorghum.

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These various sorghums became very widely disseminated, and during the past quarter of a century there has been produced annually throughout the south, south-west and the west a large quantity of sorghum syrup, generally of an inferior quality, with a rank and disagreeable taste, but not infrequently as good as even the best product from the sugar cane.

In 1862 John Stanton Gould, after an extended tour of observation throughout the western states in the sorghum-growing districts, made an exhaustive report upon this industry to the New York state agricultural society. He says that in Quincy, Illinois, an acre was reported to have given 500 gallons of syrup; an acre in Belmont county, Ohio, 420 gallons; an acre in Muskingum county, Ohio, 600 gallons. But he says, "the largest production I was able to verify was 320 gallons per acre, in Henry county, Indiana."

He says that the average amount of seed produced is 38 bushels per acre.

He found only two farmers who had weighed their crop of cane produced, and they obtained as follows: Mr. Pomeroy of Sycamore, Illinois, 16 tons per acre, and Mr. Hedges 17 tons per acre.

He found the average cost of making syrup to be 10 cents per gallon, or by halves. A three-roll vertical mill gave from 55 to 60 per cent of the weight of the stalks in juice, but the heavier mills, he adds, with horizontal rolls gave from 65 to 70 per cent. Mr. Gould gave also careful estimates of the comparative production, cost and profit of wheat, corn, oats, potatoes and sorghum as follows for an acre of each of the above crops:

Wheat,	15 bushels, cost $13.97	or 93.1	cents	per bushel.
Corn,	60 bushels, cost $19.60	or 32.6	"	"
Oats,	38 bushels, cost $13.63	or 35.8	"	"
Potatoes,	75 bushels, cost $24.20	or 35.3	"	"
Sorghum,	150 gallons, cost $45.21	or 30.1	"	per gallon.

If, he says, wheat brings in market $1.00 per bushel, then it would give a profit of 7 4-10 per cent and, with wheat as a basis for calculation, at the same profit for the other crops corn should sell for 35 cents, oats for 38.4 cents, potatoes for 37.9 per bushel, and sorghum syrup at 32.3 cents per gallon. But while the above fairly represents the selling prices of the other crops, sorghum syrup sells readily at 50 cents per gallon, or at a profit of 66 1-10 per cent.

In other words, while 50 acres of wheat at 15 bushels per acre would yield 750 bushels, costing $698.50, thus giving $51.50 profit, 1 3-4 acres of sorghum at 150 gallons would cost $78.93, thus giving $53.32 profit. In short, he concludes that sorghum is vastly more profitable than any other crop the farm can

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raise. A careful review of his figures appears to show the same fact to be true to-day.

But as is well known the sorghum industry has declined of late years, due mainly, if not wholly, to the inability to produce a crystallizable syrup, and owing to imperfect methods the syrup which was produced in the large majority of cases was of very inferior quality and not infrequently quite unfit for use. But occasionally it would happen that some farmer found his syrup to crystallize well, when an attempt to repeat the experiment would result in failure. Such from the first has been the universal experience, and one will find in the literature of the subject which records the results of the past 25 years in this industry, abundant and respectable authority for almost every statement, often quite antagonistic among themselves, and leaving the one seeking to learn the proper method of procedure entirely in doubt.

This condition of affairs was clearly recognized by Mr. Gould in 1862 when he said in reference to this industry: "These conflicting opinions might easily be reconciled by a few well directed experiments." Again, he says: "After the most careful inquiry, orally and by letter, I am unable to find that any such experiments have ever been made."

Had his suggestions been carried out, there can remain no doubt but that we might have saved since 1862 over one and a half billion dollars, the amount since that time paid out for foreign sugars.

Indeed there can be no doubt but that had a careful series of experiments been made any time within the past 25 years, the most important practical results could not but have followed, and that the remarkable discovery which has aroused so general interest throughout the country could not but have been recognized at once.

There is, perhaps, nothing which has characterized the industrial development of this century more than the efforts which have been made, often in thehighest degree successful, to utilize waste products. As an illustration a number of important of industries are at present established depending for their raw material upon the offensive product, once wholly wasted, the coal tar of the gas works. So in agriculture it is beyond question true, that in regard to our vast crop of maize, which at present occupies 38 per cent of all our cultivated land and the aggregate value of which crop approximates $500,000,000 yearly, still it is beyond doubt true that not over one-third of the value of our corn crop has been utilized. The stalks, nearly all of which are wasted, contain an amount of sugar,

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far greater in value than the ripened grain, and indeed, after the extraction of the sugar, there still remains in the pressed stalks an amount of nutriment fully equal for feeding farm animals to the value of the grain, and yet the grain for the present and for a century past has been considered the only portion of this invaluable crop worth the saving.

In illustration of this matter and to show the enormity of this waste, let us consider the sorghum crop. As has been seen, the average yield of grain is equal fully to the average production of maize, and for food for farm animals it has been found in practice fully equal to an equal weight of maize, and chemical analysis shows this experimental conclusion, as to its food value, fully sustained as will be seen by the following analyses of sorghum seed and maize kernel:

PROXIMATE ANALYSES OF THE SEEDS OF SORGHUM AND MAIZE.

	Seeds of the Early Amber Sorghum.	Seeds of the Chinese Sorghum.	Average of 8 Yellow Corns.
Water,	10,57 per ct.	9.93 per ct.	9.36 per ct.
Oils,	4.60	3.95	5.36
Sugar,	1.91	2.70	2.16
Albumen,	2.64	2.64	4.85
Zein,	7.34	6.90	5.92
Cellulose,	1.48	1.52	1.25
Gum,	1.10	.72	1.90
Ash,	1.81	1.47	1.53
Starch,	60.55	70.17	67.67
	100	100	100

But suppose, after securing the ripe seed of the sorghum, we should gather in heaps the stalks and burn them, as is often the case with those of maize, or even allow them to decay upon the land, is it not obvious that by such a course we should throw away fully three-fourths the value of our crop? In a similar manner may it be shown by the results given further on in this discussion that we have thrown away fully two-thirds the value of our corn crop.

So, too, in regard to the sugar cane of Louisiana; it is a generally acknowledged fact that from 40 to 50 per cent of all the sugar present in the cane is annually lost through wasteful processes employed in its extraction. But at the same time we have, in the history of the development of the beet sugar industry a record of what may be done and has been accomplished in applying methods which have been devised by science; for from the very first this important industry has received the patronage of science, and it has been found practicable to secure from the beet nearly the entire amount of sugar

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present in the root, and thus to establish an industry which in the production of the world's supply of sugar has become an important rival of the sugar cane, a plant richer in sugar, far more readily grown, and incomparably superior as a profitable source of sugar to the sugar beet.

Another question of tremendous practical importance arises in connection with our production of cereals.

By reference to the reports of the department of agriculture for the years 1862 and 1877 it will be seen that the average acreage yield of the 10 western states, including Ohio, Indiana, Illinois, Michigan, Wisconsin, Iowa, Minnesota, Missouri, Kansas and California was in 1862, for corn, 38.5 bushels; for wheat, 17.8 bushels.

The average yield for the 11 eastern states, including Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, Pennsylvania, New Jersey, Delaware and Maryland was in 1862, for corn, 33.5 bushels; for wheat, 16.8 bushels.

These same 10 western states gave an average acreage yield in 1877, for corn, 30.6 bushels; for wheat, 14.8 bushels.

The 11 eastern states gave an average acreage yield in 1877, for corn, 33.2 bushels; for wheat, 16.1 bushels.

From the above it will be seen that during this short interval of 15 years the average acreage yield of these western states had fallen off, for corn, from 38.5 bushels to 30.6 bushels, or 20.5 per cent, while this falling off for wheat was from 16.8 bushels to 14.8 bushels, or 16.9 per cent. Besides, it appears that the falling off in the average production of the 11 eastern states during this same period was, for corn, from 33.5 bushels to 33.2 bushels, or .9 per cent, while the falling off for wheat was from 16.8 bushels to 16.1 bushels, or 4.2 per cent. It also appears that if we consider the case of the older western states comparatively, the result is still more alarming. Illinois, for example, which in 1877 produced by far the largest crop of corn of any state in the Union, nearly double any other, gave in 1877 an average acreage yield of corn of 29 bushels, while in 1862 the acreage yield of corn in Illinois was 40 bushels or a falling off of 27.5 per cent. Indiana gave in 1862, 42 bushels, in 1877, 30 bushels, or a falling off of 28.6 per cent.

It also appears that in 1877 the acreage yield of the eastern states was, corn, 33.2 bushels; wheat, 16.1 bushels; while in the western states in 1877 it was, corn, 30.6 bushels; wheat, 14.8 bushels. From this it will be seen that we of the east have not only maintained practically the fertility of our lands, but that we are to-day securing larger crops, 8.5 per cent more corn and 8.8 per cent more wheat,

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upon lands which have been under the plow for a century longer than have those lands of the west.

In view of these results showing conclusively the rate of exhaustion which has been going on throughout the west, and which has been a matter of common observation for many years, it certainly shows that at no distant day the profitable production of these two important cereals will be, with our present methods, an impossibility.

We have been too much inclined to accept the glowing statements of those who have spoken of the exhaustless fertility of our prairies and have regarded them as capable for all time to support the teeming millions of the future. The above facts show this prospect as quite visionary, and although perhaps there hardly exists as yet great cause for alarm, there still is reason for a careful review of our agricultural resources, and the abandonment of our wasteful methods and the adoption of such practices in agriculture as have received the approval of science, and met the test of long experience.

The causes of this rapid exhaustion of our western lands are not far to seek. It is doubtless true that as a rule better practices prevail in the east, but though much may be due to these general causes, it is probably mainly due to the character of agricultural products of the west as compared with those of the east. At the east mixed farming generally obtains, and a very large proportion of the products are consumed upon the farm. At the west the cereals are produced and shipped from the farm, to be consumed at other and distant points.

That we may estimate the immense extent of this exhaustion let us consider the corn crop alone, of which by far the largest amount is produced in the west.

In 1877 the amount of corn produced in the United States was 1,342,558,000 bushels, equal, at 56 pounds to the bushel, to 37,591,624 tons. By reference to the report of the department of agriculture for 1878, page 151, it will be seen that of 28 specimens of corn analyzed there was found an average of 1.63 per cent of ash or mineral matter taken from the soil. It appears, then, that our corn crop annually removes from our soil 612,743 tons of mineral matter. Now by reference to page 151 of the report for 1878 it will be seen that the analysis of 6 samples of ash from corn gave an average of 46.53 per cent of phosphoric acid and 32.56 per cent of potash. It appears, then, that our corn crop annually removes from our soil 285,110 tons of phosphoric acid and 199,509 tons of potash.

There are few who need to be reminded that these compounds are the two most valuable constituents of our commercial fertilizers, and

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for which agricultural chemists are agreed that the following are fair prices, viz.: 12 1-2 cents per pound for phosphoric acid and 7 cents per pound for potash.

It appears, then, that the annual corn crop of the United States contains as follows:

285,110 tons phosphoric acid, at $250	$71,277,387
199,509 tons potash, at $140	27,931,299
Total	$99,208,686

Now the entire value of the corn crop for 1877 was estimated at $480,643,400. It appears, then, that these two constituents, present in the ash of the corn crop, are equal in value, at those prices which agriculturists freely pay for them in the various commercial fertilizers, 20.64 per cent of the total value of the corn crop. And when the time comes, as come it assuredly must, unless our experience is to be wholly unlike that of other countries, when to increase the production of our lands we must have recourse to the same methods which have long obtained in Great Britain and upon the continent, and in the New England, Middle and Atlantic states of our own country, viz., the application to our soils of these same compounds which now are being so rapidly removed—then it will be found that the profitable production of the cereal crops at such prices as now obtain for them will be an impossibility. Indeed, even now in many parts of the west the continued production of corn as in the past is regarded as almost without profit.

That we may see to how great an extent this trade in commercial fertilizers is carried a few statistics will suffice. In 1879 there was sold in the state of Georgia about $3,000,000 worth of fertilizers; in North Carolina during the same year, $2,000,000.

In the year 1870, according to the returns furnished by the London board of trade, there was exported into Great Britain, chiefly for England, with an acreage only a little larger than that of New York, 394,843 tons of raw fertilizing materials, worth $20,049,042, from all parts of the world. Nor does this include her immense home resources in the way of phosphates from the counties of Suffolk, Cambridge, Bedford and Buckingham, nor the enormous importations of grain and breadstuffs for consumption within her borders, all of which go to add to the supply of fertilizing material which makes good the annual production from her farming lands. The immense importance, then, of effecting a change in the character of our agricultural products, especially of such as are to suffer transportation from the country or from the farm, becomes apparent. As is well known, sugar is composed wholly of atmospheric

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constituents, and it would be quite possible for us to supply the world with sugar for centuries, while our lands meanwhile would but increase in their fertility. Mr. Gould, already quoted, says: "If the begasse is returned to the soil sorghum might be cultivated for ages without impoverishing it." Again he says: "Begasse rots more rapidly than any similar substance that I have ever met with; after laying in heaps 4 months it breaks up almost into a powder, and may be plowed in without incurring the slightest danger of clogging; and such practice cannot be too highly recommended." And again he says that "Cows feed on this begasse with great avidity when recent, and it uniformly increases their flow of milk." This last matter, already alluded to, is so important that especial attention is directed to the results given in the following analyses of pressed and unpressed stalks of corn and sorghum:

PROXIMATE ANALYSES OF EARLY AMBER SORGHUM STALKS AND CORNSTALKS, PRESSED AND UNPRESSED.

	Early Amber Stalks Unpressed.	Corn-Stalks Unpressed.	Early Amber Stalks Pressed.	Corn-Stalks Pressed.
Organic acids and Chlorophyll,	7.36	2.85	1.47	1.11
Wax,	.94	.44	.35	.40
Brown Resin,	6.98	8.11	5.11	5.75
Sugars	34.73	26.01	19.36	10.08
Gum,	2.14	1.38	2.04	1.33
Starch Isomers,	20,34	22.44	31.46	23.16
Albuminoids,	4.95	6.90	3.96	6.04
Alkali extract		6.09	13.35	22.26
Crude fiber,	16.01	19.82	19.10	25.00
Ash,	6.55	5.96	3.80	4.87
	100	100	100	100

From the above analyses it will be seen that the nutritive value of the pressed stalks is nearly equal to that of the unpressed stalks, since there remains a large percentage of sugar which is not expressed, while the starchy compounds are, in the case of the sorghum, more than 50 per cent greater in the pressed than in the unpressed stalks. As will be seen, also, the other valuable nutritive elements, the albuminoids, have by pressing been diminished only about one-fifth in quantity. If now we take into consideration the greatly improved mechanical condition of the stalks which, by having been passed between the rolls, have been very thoroughly disintegrated and rendered much more available as food, it will appear that for equal weights, it is without doubt true that the pressed stalks, if carefully preserved according to the system of ensilage, which has been an established practice in France for years, and has already

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been successfully introduced into this country by Mr. Bailey of Billerica, Mass., that these pressed stalks will be found a most valuable addition to the supply of food for our animals during the winter and early spring months.

It is well known that all animals readily and even ravenously feed upon these pressed stalks when fresh from the mill, but owing to the readiness with which they enter into fermentation they speedily become unfit for use as food, and it is only by packing the freshly pressed stalks in pits and, by means of a covering of straw and earth excluding completely the air, that this fermentation is prevented; since, as is well known, only that fermentation known as the alcoholic or vinous fermentation is possible without access of air. This is, in short, the fundamental principle of this system of ensilage. With a view of settling this important matter and determining the possibility of the economical production of sugar in our own country from cornstalks and from sorghum there have been made during the past two years a series of experiments at the department of agriculture at Washington. The result of these experiments has been such as to have attracted the widest interest, as may be evidenced by the following extracts from editorial notices and letters from most of our leading papers.

The New York *Tribune* editorially says: "If future seasons confirm the notable results summarized in our Washington correspondence, then we may well acknowledge that the department of agriculture will have more than compensated for all its seemingly barren years. The industrial, commercial and economic bearings of this new culture and manufacture, if it becomes established as a certainty, will be immediate and remarkable. It will enable us to retain in the country the $100,000,000 of annual outgo for foreign sweets."

The Hartford *Courant* says editorially: "There seems no reason for doubting that the practicability of this discovery has been demonstrated. The importance of this may be inferred from the fact that the country now pays annually more than $110,000,000 for the sugars it imports. If this dream should be realized, there are manifestly 'millions in it' for the farmers of America, and the discoverer will take rank with the inventor of the cotton gin, the locomotive and the electric telegraph, as one of the benefactors of mankind."

A correspondent of the Detroit *Post and Tribune* says: "Without going into figures it is safe to say that this discovery is to be of more value to our country than all the gold and silver mines from Maine to the golden gate."

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A correspondent of the New York *Herald* says that "the general results of these experiments in the production and crystallization of sugar may be ranked in importance with the invention of the cotton gin." Again he says: "The rejected cornstalks would give us an income (in sugar) which, within the brief period of 10 years, would extinguish our national debt." And he coucludes his interesting letter thus: "The object of this communication is simply to herald the advent of a new industry among our people; no *morus multicaulis* fallacy, but a highly profitable field of industry, equal to the gain of $200,000,000 to the country and wide as the zone of sorghum and Indian corn."

The varieties of sorghum experimented with were 4, viz: Early Amber, Chinese, White Liberian and Honduras. The seed was planted in drills 3 feet apart, on the 15th day of May, and so soon as the seed heads began to appear examinations were made of canes selected from these different sorghums, and these examinations were continued at intervals of from 3 to 5 days during the entire season. The condition and degree of development of the plant was also made a matter of record, so that the common farmer might for himself judge when the proper season had arrived for cutting and working the canes. Besides these sorghums there was a series of examinations made of pearl millet.

From the results obtained in this series of investigations there have been selected 4 of each as showing the general fact which was brought out by the investigation. These results are tabulated below and will repay a careful examination.

Besides the above there were made very many examinations of other specimens of sorghum and also of cornstalks.

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	Development of plant.	Date of analysis.	Per cent of water in stalk.	Per cent of juice obtained.	Specific gravity of juice.	Per cent of glucose in juice.	Per cent of sucrose in juice.
Early Amber	Seed-head just out	July 18	82.70	34.6	1047	3.77	4.43
	Seed hardening	Aug. 16	80.07	32.7	1080	1.54	14.67
	Seed ripe, hard, dry	Sept. 16	73.20	22 9	1080	0.65	15.95
	After hard frost	Oct. 29	69.38	33.3	1088	1.10	17.00
Chinese	Seed-head just out	Aug. 6	83.99	32.7	1033	5.55	1.85
	Seed hardening	Aug. 19	78.77	29.0	1067	5.25	6.45
	Seed ripe, hard, dry	Sept. 13	71.27	28.1	1085	1.45	13 90
	After hard frost	Oct. 29	69.51	31.0	1076	1.85	13.15
White Liberian	Seed just in milk	July 26	79.32	38.5	1046	3.50	4.70
	Seed nearly ripe	Aug. 26	71.34	29.5	1082	1.40	13.70
	Seed ripe and hard	Sept. 27	71.00	21.2	1078	0.95	15.20
	After hard frost	Oct. 29	69.66	28.8	1081	2.10	13.09
Honduras	Seed-head not out	Aug. 12	84.00	34.4	1035	5.13	1.20
	Seed just in milk	Sept. 13	77.79	35.6	1055	3.80	8.40
	Seed hardening	Oct. 20	69.39	30.6	1079	1.30	15.10
	After hard frost	Oct. 29	71.42	34.5	1075	1.50	14.20
Pearl Millet	In blossom	Sept. 10	76.31	30.0	1035	1.60	1.90
	Suckering at top	Sept. 25	72.00	21.5	1054	1.10	8.70
	Leaves dying	Oct. 14	64.41	20.3	1068	2.00	11.30
	After hard frost	Oct. 29	72.54	22.0	1070	5.40	7.40
Louisiana Ribbon Cane Plant, 1879		Nov. 10	77.19		1057	1.21	12.47
Louisiana Ribbon Cane Plant, 1878		Nov. 10	81.77		1070	0.57	16.50
Do		Nov. 10	76.95		1065	1.23	14.31

It will be observed that the amount of glucose (or uncrystallizable sugar) diminishes and the amount of sucrose (or true cane sugar) increases up to a certain time in the development of the plant; that these plants differ widely as to the time when the sucrose is at its maximum, but are alike in this, that the maximum is obtained at about the same degree of the development of the plant, viz., at full maturity, as indicated by the hard, dry seed and the appearance of shoots or suckers at the upper joints of the stalk.

It is also to be observed that the heavy frost of October 24th, which was sufficient to form ice half an inch in thickness in tubs of water, did not produce any marked diminution of sugar. Three varieties of sugar cane received from Louisiana in excellent condition, and which doubtless fairly represents the average character of this famous sugar plant, were analyzed and the analyses are embraced in this table for purposes of comparison.

For purposes of comparison there is also given below the average composition of 6 specimens of sugar cane juice from cane grown in the East Indies:

Sucrose.....13.49 per cent.
Glucose.....1.73 per cent.

A fair conclusion from these investigations appears to be that there exists but little difference between the various kinds of sorghum as sugar-producing plants, and that the juice of each of them

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is at a certain period of its development nearly as rich as that of the best tropical sugar cane grown in this country.

It is a matter also of extreme practical importance that it should be known that this period of maximum content of sugar is maintained for a sufficient time to enable the manufacturer to work up a large crop of stalks. Another result of this investigation has been to satisfactorily explain the cause of repeated failure in the production of sugar from certain plants during the past quarter of a century, as also to account for the occasional successes in producing sugar. In addition to the above investigations there have been made a series of experiments with a view of determining the practicability of producing sugar from these various plants, and nearly 25 tons of stalks have been used in all these investigations, the result of which has been to demonstrate the ready production of sugar from either sorghum, cornstalks or pearl millet.

In every case (and about 40 experiments in sugar-making have been made), the juice was examined to determime the amount of crystallizable and uncrystallizable sugar present, and the syrup obtained from these juices was precisely such as the previous examination of this juice in the laboratory had made probable.

A few of the experiments made give a reasonable basis for estimating the probable yield of syrup and sugar to the acre, and therefore an approximate estimate of the cost of producing sugar.

Below is the tabulated result of a few of the experiments from stalks grown upon the grounds of the department.

These stalks were grown in rows three feet apart, two to four inches apart in the row, and although a good crop, there is no doubt that upon good land an equal yield to the acre could be readily obtained.

	Pounds of stalks from acre.	Pounds of syrup obtained.	Pounds of syrup juice at best.	Pounds of syrup juice, 70 per cent.
Chinese sorghum,	38,600	2,096	2,397	3,673
Liberian sorghum,	33,727	2,472	2,609	3,783
Early Amber sorghum,	32,415	2,100	2,615	3,661
Honduras sorghum,	66,151	3,652	5,168	7,537
Pearl millet,	65,000	1,846	3,128	4,865
Field corn,	27,240	1,166		1,807

The first and second columns give the result actually secured, but the several juices were not in their best condition as compared with the results given in the first table. The third column is the amount which this same weight of stalks would have yielded had they been cut at the proper time. The juice obtained from the stalks by the imperfect means at the command of the department was a little more

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than one-half the amount present in the stalks. The fourth column represents the results obtainable by the use of a mill that would have given 70 per cent of the juice, a result which is possible, and claimed as common by the manufacturers of the mills. There is no doubt that when the present industry shall have received the employment of the capital and scientific ability which has developed the beet sugar industry, even these results, which may appear extravagant to many, will be equaled and probably surpassed.

Although these syrups were obtained from stalks in which the maximum content of sugar had not been developed, yet they all crystallized well and yielded an excellent article of sugar.

The sugar has been separated from the Chinese sorghum syrup which gave 54.7 per cent of sugar, and from the field corn, which gave 39 per cent of sugar.

The experiments with field corn are worthy of special notice, since the results secured are not only most surprising, but contrary to almost universal belief.

The cornstalks were of three varieties, viz.: Lindsay's Horse Tooth, White Improved Prolific, and White Dent, three coarse-growing white field corns. The stalks grew in drills three feet apart and about nine or ten inches apart in the row.

The ears were plucked after they had thoroughly ripened and the husks were dead and dry; the stalks, however, were yet juicy. The corn was plump and sound and yielded at the rate of 69.1 bushels of shelled corn, 56 pounds to the bushel, to the acre. The stalks were then topped, stripped and crushed, and the juice proved to be the best yet obtained from cornstalks at any period of growth or of any variety. It is exceedingly to be regretted that this department had not during the past season an opportunity to try these experiments in the large and practical way of field cultivation which would have been befitting the importance of the occasion. Not less than an acre, and preferably five acres, of each variety of sorghum and maize experimented with should be grown and its developments should be watched carefully with the aid of all the appliances of science, throughout the season and worked up at the proper time with the best machinery attainable, and it is hoped that a matter of so much importance will receive such attention at the hands of congress as will enable the department to properly discharge its duties to the country in this regard.

The mill made use of in expressing the juice was an old sorghum mill of common construction, which, through previous use and misuse, had been rendered quite unfit to give satisfactory results. After

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most of our experiments below given were concluded, it was repaired so that afterwards its working was very much better, as will be seen by the subsequent results given further on.

The apparatus used in the experiments, besides a few barrels and pails for holding the juice, consisted of a copper tank of the following dimensions: four feet three inches long; two feet three inches deep; two feet three inches wide; a galvanized iron pan nine feet long, eight inches deep, three feet six inches wide. This iron pan was surrounded by a wooden frame of two-inch plank, so as to support the sides, and each pan was placed in brick-work with chimney, and so arranged as to permit a fire to be kept below it in direct contact with the bottom. In the case of the copper tank the flame played about the sides also, so as to heat the contents more rapidly. The galvanized iron pan was such as could readily be constructed by any ordinary tinsmith or mechanic.

The copper tank was used for defecation with lime; the galvanized iron pan for evaporation.

The process in brief is as follows: After topping or stripping the corn, or sorghum, it was passed through the mill, and when sufficient juice had been obtained it was heated in the copper tank to a temperature of 82 ° Centigrade—182 ° Fahrenheit. After the juice had reached this temperature there was added to it, with stirring, cream of lime until a piece of litmus paper dipped in the juice showed a purple or bluish-purple color. The heat was now raised to the boiling-point, and so soon as the juice was in good ebullition the fire was drawn and a thick scum removed from the surface of the juice.

After a few minutes the sediment from the juice subsided, and by means of a syphon the clear liquid was decanted off, leaving a muddy sediment which was equal to about one-tenth to one-twentieth of the bulk of the juice. This muddy sediment was then drawn off by means of a stop-cock, and filtered through a plaited bag filter, and the clear filtrate therefrom was added to the liquid previously syphoned off.

The clarified juice which, during the above operation, is not allowed to cool below a temperature of 66° Centigrade, or 150° Fahrenheit, was now emptied into the evaporating pan, and there was added to it, with stirring, a solution of sulphurous acid in water, until the lime present was neutralized, as was shown by the reddening of litmus paper when it was dipped in the juice.* The evaporation was now hastened as much as possible, and the juice concentrated to a

* Recent experiments have been made in which the use of sulphurous acid has been omitted, and the results obtained were entirely satisfactory. The process above described was in every other detail closely followed.—P. C.

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syrup of a boiling-point of 108° Centigrade, equal to 226° Fahrenheit, or thereabout.

It was the intention to concentrate the syrup still more (to a boiling-point of 112° Centigrade, equal to 235° Fahrenheit), but it was found impracticable to do so in the evaporator, as the danger of scorching it was great, over a naked flame which could not well be controlled.

When the syrup reached the density above indicated, it was drawn off into wooden tubs, the fire having previously been drawn from beneath the evaporator.

In the experiments made with cornstalks the stalks were invariably stripped, the tops being cut off at about the second joint. The percentage of stripped stalks, leaves and tops is given in this table:

	Per cent of stripped stalks.	Per cent of leaves and tops.
No. 1,	67.57	32.43
No. 2,	58.69	31.31
Nos. 3 and 4,	67.46	32.54
Average,	67.91	32.09

In those cases where the sorghum was stripped and topped the following percentage of stripped stalks and of leaves and tops was obtained:

	Per cent of stripped stalks.	Per cent of leaves and tops.
No. 5,	72.67	27.33
No. 6,	72.55	27.45
Average,	72.61	27.39

On account of the trouble in stripping the stalks, experiments were made with stalks unstripped, the tops alone being removed, and these experiments appear to prove that this troublesome operation of stripping may be avoided without any diminution of the amount of juice or of sugar obtained therefrom.

Below are the results obtained from stripped and unstripped sorghum, calculated to the raw stalks used.

By raw stalks is meant the stalks as they were cut in the field, leaves, tops and all.

	Average per ct of juice to raw stalks.	Average per cent syrup in juice.
Stripped sorghum, average of 2 experiments,	35.02	15.00
Unstripped sorghum, average of 5 experiments,	40.60	15.47

From the above it will be seen that not only was an increased amount of juice obtained, but that this juice gave an increased percentage of syrup, and there appears nothing unusual in the treat-

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ment of this juice from the unstripped cane, nor was there any appreciable difference in the readiness of the syrup to crystallize, nor in the character of the sugar finally obtained.

Although perhaps further experiments are desirable before considering this point as settled, it would appear from the above that not only was stripping unnecessary, but that it really involved a loss in the amount of sugar to be obtained; at least the above results indicate a difference of 20 per cent increase in product in favor of the unstripped cane. It is not improbable that the above result is due to the fact that the leaves in passing through the mill tended to fill up the interstices between the compressed cane, and thus prevented the expressed juice from flowing through between the rolls with the bagasse. In case of discoloration by action of moisture or other causes, it will, however, be advisable, and probably necessary, to strip the stalks.

Several experiments were also made with both cornstalks and sorghum to determine the relative value of the upper and lower half of the stalks, with the results given in the following table:

	Percentage of juice to stalks.	Specific gravity of juice.	Percentage of syrup in juice.
Cornstalks, butt ends, No. 3,	29.04	1053	14.62
Cornstalks, top ends, No. 4,	19.94	1050	13.46
Sorghum, butt ends, No. 8,	47.49	1059	16.41
Sorghum, butt ends, No. 10,	41.49	1062	16.47
Sorghum, top ends, No. 9,	43.16	1057	14.70
Sorghum, top ends, No. 11,	34.09	1059	14.26

It will be observed that Nos. 8 and 9 were the butts and tops of the same stalks, and were cut just after a rain, as were also Nos. 10 and 11, from which the rain had evaporated, and that the difference in yield of juice and syrup between butts and tops is nearly constant. The increase in specific gravity of the juice from butts over that from the top is also worthy of notice.

From the above table the conclusion from the average results is, that the proportion, by weight, of sugar in the lower half of the stalk is to the sugar in the upper half as follows: Corn butts to corn tops as 159 to 100; sorghum butts to sorghum tops as 131 is to 100. As will be seen by reference to the first table, the stalks of both corn and sorghum in the above experiment were divided almost equally by weight into butts and tops, so that the above proportion fairly represents the proportion of yield of sugar in the upper and lower half of the cane. There was a marked difference in the appearance of the juice as it flowed from the mill (that from the butts

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being lighter in color, especially in the experiments with corn,) but after clarification no appreciable difference could be observed, nor was there any difference in the product except the quantitative one above mentioned, which was, however, a marked difference. Also, there appeared to be a difference in granulation in favor of the juice from the butts.

It is obvious that there still remains much to be done in the way of further experiments before the production of sugar from corn-stalks and sorghum shall have been established upon the basis of greatest economy, but enough seems to have been determined to indicate clearly that there is in this new industry the prospect of a revolution in our agricultural methods.

It is most desirable that these results which have been secured at Washington should be repeated, not only there but elsewhere, to determine what effect may be produced by changes in soil and climate.

There still remain some twenty other varieties of sorghum, some of which may be found even superior to those varieties already tested. There also remains much to be done with our different varieties of maize. It is not unlikely that certain varieties may be found far surpassing others in their production of sugar; nor is there reason to doubt but that the skillful hybridist, like Mr. Pringle of Vermont, may succeed in developing new varieties of both sorghum and maize far superior to any now known.

In view of the importance of this matter, and in consideration of what has been already done to develop the beet sugar industry by some of the states, it would seem wise if our state agricultural societies or state boards of agriculture should offer prizes for the greatest product in sugar or syrup from an acre of corn or of sorghum, and there is no doubt but that the stimulus of a prize of $100 or $200 would secure many competitors and result in rapidly developing this new industry.

Finally, for those who contemplate experimenting in this direction, a few hints will doubtless be acceptable as to the methods which at present seem best from the results of the experiments already made.

1. Plant only that variety of sorghum which will mature long enough before frost to enable the crop to be worked.

2. Allow the seed to become perfectly ripe as evidenced by its being hard, dry, and shelling somewhat upon handling.

3. Cultivate and plant as for corn, in drills or in hills.

4. Work up the cane as soon after it is cut as possible, since stand-

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ing will not injure it; and hasten every operation from the expressing of the juice to the concentration of the syrup.

5. Secure a mill which will give the maximum amount of juice, 65 to 70 per cent of the weight of the stalks.

6. Do everything quantitatively, by weight and measure and time, and nothing by guess, and keep a record of your results for yourself and others.

In the above described process the use of a solution of sulphurous acid is mentioned. The employment of this compound, in the manner above described, has been secured by a patent. This compound, however, has been used for many years in the manufacture of sugar from sugar cane, and at present, so far as I know, its use has been entirely abandoned by those engaged in this business. Whether its use is to be recommended in the production of sugar from maize or sorghum still remains in my mind a matter of doubt. Certain it is that excellent sugar has been made repeatedly, and in considerable quantity, by many parties and in different sections of the country without using this compound, and there appears no good reason to suppose that if it is not desirable in the production of sugar from the juice of the sugar cane, that its employment is indispensable when working the juices of the mature sorghum or maize stalks. It is the intention to subject this matter to test the ensuing season.*

The use of lime in defecating the juice is essential and its use is universal, nearly, upon every sugar plantation of the world.

* See foot-note, page 235.

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WHAT SORT OF AN EDUCATION SHALL WE GIVE TO THOSE OF OUR CHILDREN WHO ARE GOING TO BE FARMERS?

By President M. H. BUCKHAM, Burlington.

Important as are all the questions we have been considering in these meetings, questions relating to the farm and the stock, they are but secondary to the questions that relate to the human beings who have dominion over the earth and all that it produces. No topics are more appropriate, none should be more cordially welcomed, to farmers' gatherings, than those that bear on the happiness and the improvement, intellectual, social and moral, of farmers and their families.

In order to answer this question, "What sort of an education shall we give to those of our children who are going to be farmers?" a question which many of you, I know, are asking with great earnestness, I shall ask and answer it as though it were a personal concern of my own: "What sort of an education shall I give to a child of mine who is going to be a farmer?" So you will get my best and sincerest thoughts on the subject, however much or little they may be worth. I will suppose that I have a boy who is going to be a farmer. Let us, for convenience, call him George, which is a good farmer's name, inasmuch as the word itself means farmer. The question then is, how shall I educate George? Now, although I should very much like to have one of my boys become a farmer, because I believe that a farmer's life may be as honorable, happy and useful as any life, I have no means of knowing that George will actually be a farmer. I do not consider that I have any right arbitrarily to choose my boys' occupations for them any more than I have to choose their wives for them.

The system of caste, which requires that every boy should follow his father's occupation, is a tyrannous and cruel system. But in this free age and in this free land, one of the best opportunities a young man has is the opportunity of freely choosing his own calling among all those open to honorable ambition. A good deal is said against academies and colleges on the ground that they "educate young

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men away from the farm." I know a man who says: "I want my boy to be a farmer. I want him to take the farm when I am through with it and to stay on it and take care of the old folks. If I send him off to school, he will get weaned from the farm and go into some profession. I will give him just a good common school education; that is all that a farmer needs. Then he will stay at home and be a farmer." But one of the rights which God gave that boy was the right to make the most of himself in any sphere of life which he might freely choose. And yet the father, who ought to be his best helper, robs him of that right, and says, virtually, "I will fix it so that he will never have a chance to choose any other calling and will never know that the chance was taken away from him." Why, if all farmers' sons were to become farmers, as some think they ought, what would become of the professions, and what would become of the world? Go through all the callings of life and pick out the most capable men in them, the greatest lawyers, statesmen, preachers, physicians, teachers, inventors, the men who are doing the greatest service to mankind, and you will find that the great majority of them came from the farm, or are removed from it by only one or two generations. Young men are constantly going from the farm to carry fresh vigor into other vocations, and others are constantly coming back from the professions to renew their exhausted vitality by restoring their connection with old mother earth. It is a strange thing to say, but I really think it needs to be said to the fathers—though perhaps not to the mothers: "Don't be jealous of your boys; don't grudge them a chance to rise; give them an opportunity to be something besides farmers if they want to be." But George says he wants to be a farmer—just as Willie has decided to be a lawyer, Tom a physician and Jack a locomotive engineer. George is only a boy. His notion of being a farmer is only a little boy's fancy. He may change his mind many times before he becomes a man. The smallest possible reason for fixing a man's career is a boy's whim—and any preference of a boy of ten or twelve can be little more than a whim. But cannot a wise parent or teacher discover a boy's talents and aptitudes and so reveal to him the career for which he is fitted and persuade him to follow it? I answer, only in the case of some very remarkable boy who, like Pascal or Mozart, early shows the unmistakable call of providence in very marked talents. The ordinary boy's capacities do no appear until education has brought them out, and often not even then, not until practical life has tested them. George may be a farmer, but he may not be. For the pres-

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ent, then, it is very plain that I must not educate him as though I knew he was going to be a farmer, except so far as that education would be equally good for any other calling. But fortunately the groundwork and rudiments of all education are the same. I will, then, give him a good elementary education. Now that means a good deal. Very few boys get a good elementary education. To be able to read well, that is, to read correctly as regards pronunciation, distinctly as regards utterance, agreeably as regards tone and modulation and expressively as regards emphasis, to be able to read by the eye rapidly and to the ear effectively, not so as to satisfy a dramatic critic, but only in a homely and unprofessional way; to be able to write well, easily to one's self, legibly and not distastefully to others; to be able to spell correctly, even when writing rapidly; to have mastered the elements of arithmetic as applicable to the ordinary calculations of business; to know the general distribution of nations and tribes over the globe, with the leading physical facts which determine their characteristics and shape their career; to know something of the laws of our own language, so far at least as to avoid vulgar errors of speech; to have learned the great outstanding facts in the history of one's own nation and state; to have accomplished all this, which is fairly implied in a good elementary or common school education, is a task which will have required a good deal of watchful exertion on the part of both parent and child.

Shall I send my boy to the public schools, where I cannot have my way about his studies, or shall I, if I am able, put him in a private school where I can to some extent prescribe the course he shall pursue? After much thought on that question I have come to this conclusion: I will put George into the public schools on account of the healthful stimulus which publicity and free competition give to the schools, but I will use my utmost influence to make them as good as they can be made. I will, so far as I am able, see to it that the buildings, the furniture, the apparatus, and above all the teachers are the best that my district, my village or town can be persuaded to provide. I will tax myself and do my utmost to persuade my neighbors to tax themselves enough to maintain the very best school we can afford.

But George's education does not depend on the school alone. It is very important that he should form the habit of reading good books. But I cannot afford to buy him all the books he will need; he must have access to a good library. I must therefore stir up my neighbors to start a village or town library. In most of the towns of Vermont this is a work which will have to be begun from

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the bottom. In Massachusetts, a large number of towns appropriate the proceeds of the dog-tax to the support of libraries. If we cannot come by the means in any other way, let us, in this state, not disdain the help of the dogs in getting books for the boys.

George's education will also largely depend on influences that come to him through his religious teacher. This matter is appreciated far less than it should be—the educational value of religion, the educational power of the religious teacher. It is of the greatest conceivable consequence to George, in respect to his education merely, and apart from all considerations of his religious culture, that he should sit under the ministrations of a man of intellectual and moral force. Preaching does as much to awaken and stimulate the intellect as teaching. I will therefore do my best to get into the pulpit under which George sits, a man who will interest, instruct and quicken him. I will take good sterling newspapers and periodicals, both religious and secular. In this way I shall get before his mind, long before he is able to master them, but not too early to make him thoughtful and inquisitive, the great questions of the time, and the questions of all time, and of eternity.

Well, in this way I have got George pretty well educated up to a certain point. He has got a good elementary knowledge of numbers, of geography, of the grammar of his own language; he can spell, and write, and perhaps draw a little. He has acquired a love of good reading, which is best of all. I should like to add that he has learned something of what we call nature, that is, of the beings and things that occupy this earth with us, the stones, the plants, the animals. That will doubtless come in time to the future Georges in the common schools, but at present there are few teachers who can teach these things, and the sciences themselves are not yet so simplified that they can be taught to children. George has got, at 14 or 15 years of age, about the education which the common school system has given to the great mass of our population for the past fifty years—improved somewhat, let us hope—by modern devices. Now, if I have done my duty and he has done his, the boy has got an education which is not to be despised. If he make the most of it hereafter, extending his information by reading, using his opportunities to profit by intercourse with superior men, above all putting thought and plan into his business, and so being constantly educated by it, he may become a man of fair intelligence, competent to do the duties of a man in the humbler walks of life. If he have unusual native power of mind, he may do much more than this. Such a mind will often burst through the limits which beset half-

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trained minds of ordinary capacity and find or make itself a way to knowledge and power. These are the few cases which mislead the popular judgment. Because here and there one, rarely gifted, most rarely gifted with that indomitable perseverance which makes light of toils that would kill ordinary men, rises to eminence without the direct help of academies and colleges, it is inferred that ordinary men, of average talents, with moderate education, may do the same. But George is an ordinary boy. Even parental fondness has not discovered genius in him. If it had, that would be an additional reason for putting these rare gifts under training. But it is plain to me that the ordinary laws of human nature have their way with George, even though he is my boy. The question now is, shall he go on with his education? shall he go for some years to the high school or academy? The result of much thought on that question is, he shall go, if I can afford it. And I will not be selfish or penurious in deciding whether or not I can afford it. I will scrimp, if I must, somewhere else, not here. I will get up an hour earlier or work an hour later at night, if I must, so that George may have a good education. What he has got hitherto I do not call a good education. It is good, I hope, what there is of it, but if it is my duty to give my boy a *good* education, I have not done all my duty in giving him a common school education merely,—not if by exertion and sacrifice I am able to give him a better one. Some will say that this is the point when it must be decided whether or not George is going to be a farmer, because if he is, most of what is studied in the higher schools will be of no use to him. What use can a farmer make of quadratic equations and hypotheneuses and hydrodynamics? Well, certainly, as much use as a lawyer or a doctor or a minister. "Just so," says one, "a large part of what they study in these schools is of no use to any one." And yet it does appear that those who have gone through this training are, as a general rule, brighter, more capable, more accomplished than those who have not. They can solve difficulties in life more easily, think more clearly, calculate probabilities with better forecast, adjust means to ends with better judgment. If this is so, and few intelligent persons will deny it, then every father will want his boy to have this training. George, then, shall go to the high school, if I can afford to send him, farmer or no farmer. Here he will carry forward the studies of which he learned the rudiments in the common schools. He will carry the study of mathematics onward to those problems which are not less practical because they are more abstruse. He will go more thoroughly into the study of his own language. He will make acquaint-

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ance with some of the master-pieces of literature. He will learn to write and to speak in such a way as to be able hereafter, when he has something to say, to instruct and please and persuade his fellow men. He will be introduced to those wonders of physical science of which the world rings from side to side. Shall he learn Latin? Shall a boy who may possibly be a farmer learn Latin? You would think, to hear some men talk, that there was something awful in the idea; that no farmer could expect to have his seed come up or his cattle bring forth after their kind, who so far tempted providence as to have learned Latin. The answer will depend, not on his prospect of being or not being a farmer, but on the means and disposition he may have, or I for him, to extend his education over several years to come. If he aspires to be a thoroughly educated man, farmer or no farmer, he will need to learn Latin.

Of course all farmers cannot be thoroughly educated men. In the present state of things few can aspire to that luxury. So far as concerns the great mass of farmers' sons in Vermont, my work is mainly done in urging them up to a good elementary and English high school education. But the question of going farther is an open one to a good number, to a much larger number than are aware of their opportunity. The point now is, then, if they are going much further they will need Latin, because the study of Latin will make many other studies easier and more fruitful. I dwell on this question, because it comes up at the dividing line between what is called a practical and a liberal education. More than any other question it brings parents to consider what education is, what it aims at, what it is good for. When a man comes to see that some study, Latin for instance, can be of no direct use to a merchant or a manufacturer, or a farmer, and yet that the man may be more of a merchant, manufacturer, or farmer, and more of a man, for having studied it, he gets a new conception of education which leads to important consequences. I should like to have George become a thoroughly educated man, farmer or no farmer, and if a good deal of exertion and sacrifice on my part will make that possible, he shall be. But most lives are subjected to limitations. If the way to that seems to be shut against him, he must make the most of the opportunities providence gives him, and even so may enjoy a great many of the pleasures and gains which only the highly educated man enjoys in the fullest measure.

It is not necessary now to go on and discuss the question whether George shall go to college, because the principles already settled in my mind will lead me to desire that he should go, if circumstances

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permit. I refuse to allow that the probability of his being a farmer will make any difference in the question. I can see no good reason why I should favor the boy who is going to be a lawyer or a physician, over his brother who is going to be a farmer, by sending the one to college and not the other. It would be just as unfair as to leave twice as much of my property to the one as the other. The farmer needs the education as much, and can make as good use of it, as the lawyer. I admit that the probability of his actually becoming a farmer grows less the more education you give him, and that simply because his education has given him the power to gain more of the desirable things of life with less work in some other way than by farming. But as the professions become more crowded, and competition grows fiercer, and as farming becomes less an operation of mere manual labor, and more one of skill and contrivance, more educated men will be attracted to agriculture, and education will become more and more the road to success and enjoyment in this as in all other pursuits.

Let us then, in closing this point of the subject, rest it on this general principle: that before we come to the special education which shall fit one to become a farmer, a professional man, or whatever else, we will give him as extended and liberal an education as the circumstances will admit; the more, the better; the more thorough and scholarly, the better; the more varied, the better, provided each part be thorough; the more extended, the better, certainly up to the time of his majority, or even a year or two beyond. How much education it is in the power of a Vermont farmer to give to his boys, will depend on how high a value he sets on education, and how ambitious they are to get it. If from that small, stony New Hampshire farm Ezekiel and Daniel Webster could find their way to college, the same faith and heroism in father and mother and boys, could make the way to college possible—it is not necessary that it be made easy—from almost any farm in Vermont.

But has George done nothing but study all these years? Has his life been all books, books, study, study, and nothing else? Not so, if I am a wise father. The number of hours in a day, the number of days in a year, that can be perpetually devoted to pure mental activity, without exhaustion to the mind and a strain upon the body, are fewer than we think to be; we sit down and calculate them, and see how large a margin we have left for other occupations. And besides, an important point of education has to do with matters that books and school teachers have no concern with, the training of eye, ear, hand, muscles; the development of the body to strength and

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agility; acquiring knowledge of common things, and getting, little by little, common sense; in short, that education by work, and experience, and responsibility, through which boys become vigorous, knowing, capable, in practical affairs. Now in this part of education farmers have a great advantage over most others in the management of their boys. There is always something at hand for boys to do in the time not required for study. A farmer's boy learns to be industrious, handy, thrifty; he gets a vast amount of knowledge by dealing with stones, trees, horses, cattle, birds, bees, grasses, grains, fruits, wind, weather, country stores, peddlers; he has a thousand opportunities for getting varied knowledge which the village boy lacks. He has work entrusted to him, and gets independence and manliness through the sense of responsibility.

Now all of these years George has been acquiring this kind of education along side of the other. At least, your George may do so. What I am going to do with my village George, is a much harder question, and is, in fact, one of the hardest of questions. I am thoroughly convinced that every boy should be trained to some kind of industry—I do not mean a mere amateur, half-work, half-play kind of employment, but to some one of the great, necessary, bread-winning industries of mankind. I do not think that good health, good habits, right notions of life, can be secured to boys so effectually in any other way. The notion which village boys are getting, that going to school five hours a day, for five days in the week, for nine months in the year, exempts them from work for all the rest of the time, breeds habits of idleness and self-indulgence, which result in wasted and vicious lives. How to give to village boys the employment which they need, is a hard problem which is now occupying the attention of thoughtful men. But fortunately for you, it is not your problem. The chances are all in your favor that your boy will learn industry, economy, the value of time, and most of the essential, if homely, virtues, through the experiences of life on the farm.

But sooner or later George must make his choice of a calling, and we will assume that he chooses to be a farmer. He has good reasons for his choice, and he chooses for those reasons, and not from necessity or whim. Because farming is an active, out-door, healthful employment; because it is an honorable and useful calling; because it ensures a competency and holds out the prospect of a moderate and comfortable degree of wealth; and because it gives opportunity for the exercise of all the virtues, the cultivation of all the graces and the enjoyment of all the substantial comforts of life—he delib-

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erately makes up his mind to be a farmer. He has already done much in the way of preparation for his life-work. He has got considerable training of muscles, of senses, of mind. He has acquired considerable useful knowledge, and the power and desire to get more. And now, just as a well educated young man turns his attention to the law, or to medicine, or divinity, he applies himself to the study of agriculture. He is not intending to be a gentleman farmer, but is going into the business for the purpose of making a living. What, then, shall his special education for farming be?

Agriculture is an art—not a science. There is no science of agriculture any more than there is a science of medicine. Men sometimes speak loosely of the science of medicine; there is no such science. A science is something more than a mass of information—it is a body, an organized system of truths and principles established beyond dispute. But although medicine is not a science, there are many sciences relating to medicine, throwing light on it and guiding it on its difficult way, such as chemistry, comparative and human anatomy and physiology. Teaching is not a science, but there are various physical, mental and moral sciences which render important help to the art of teaching. So agriculture, though not a science, is surrounded by sciences which throw light upon it. And if we might call an art liberal in proportion to its affiliation with science, then agriculture is the most liberal of all the arts, for it is allied to more sciences than any other. Step out upon yon land and pick up a handful of soil, and before you can answer all the questions which that soil puts to you, you must know something of mineralogy, crystallography, organic and inorganic chemistry. Stoop down and detach a single blade of grass with its roots, and you have in your hand all the essential data of the problem which that most interesting and wonderful science of botany is called to solve. Crawling about under your feet, humming around your ears, infesting the plant you have in your hand, disputing with you the possession of the air you are about to take into your lungs, are living creatures whose structure, habits and relation to other organic life form the science of entomology, which is only one department of the vast science of zoology, which treats of all animate beings on the earth and in the air and in the sea. Every plant that grows on your farm, every animal in the stock-yard, every bird and insect that hovers in the air, every implement of husbandry, every road, fence, drain, farm building, every running stream, swamp, muck-bed, forest, every change of temperature, rain storm, drouth, every bare rock upheaved to the sun—everything, in short, that the farm-

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er's eye rests upon or his ear hears as he looks and listens by day or by night, represents to him a science which lies very close to his work and which it is his interest to know. Indeed, it would be difficult to name a science in all the circle of them, which does not bear, immediately or remotely, on agriculture. George has learned something of these sciences in his general training, but he pursues them now not for purposes of training but for knowledge. He has learned the fundamental principles of chemistry, botany and physiology; he should now pursue them into those details which touch the operations of farming. He studies chemistry as related to soils and the food of plants; botany as related to seeds, growth, propagation, hybridizing, grafting, irrigating, pruning; physiology as related to the care and feeding of animals, breeding, fattening. His studies must now be real, connected with actual things, not mere pictures and illustrations of things. Where shall he go to learn these sciences? To an agricultural college? Certainly to some institution where the elaborate and expensive facilities necessary for prosecuting these studies are provided, if he can afford it. Certainly also to an institution which teaches these sciences not only in their abstract and general character, but also in their special applications to agriculture. To an agricultural college, then, I should wish to have him go, to learn the special sciences which relate to his calling. If these institutions, novel as yet and inexperienced in their work, are not able to afford him all the aid which some think they might render, they can still put him far in advance of what he would be without their help. If they have much to learn, they can already teach much that is worth learning.

But where shall George learn the practical part of farming? Certainly not from books or lectures or from any instructions of men, themselves inexperienced, but on the farm, in the actual operations of bona fide farming. Experimental farming, amateur farming, fancy farming are all instructors and I should wish to have George keep a shrewd eye on all innovations and be ready to learn the lesson which they have to teach. But the kind of farming from which a boy learns most is farming pursued as a business, and for the purpose of making a living. When George has finished his scientific studies, or while he is pursuing them if it can be arranged that he can study winters and work summers, I should like to put him to work on some well managed farm, where he will see and share in all the operations of a diversified agriculture. This is the practice pursued in parts of the world where agriculture reaches its highest perfection, in the south of Scotland, for instance. There the lads

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who are going to be head-farmers or stewards are first thoroughly educated in the schools and are then sent to spend a few years with a "scientific farmer," as he is there called; that is, a practical farmer who understands all branches of the business and has in operation on his farm, usually a large one, all the most approved methods. There he serves a sort of apprenticeship, giving his labors for the instruction he receives. Possibly some modification of this plan will be found to work with the farms attached to agricultural colleges, so that they can be at once models for instruction and remunerative, or, at least, self-paying, as farms. But farming can be learned no where but on a farm. A learner must for a time be an apprentice, either to some one else or to himself. However wise he may be in the theory and principles of agriculture, he will be a bungler and a loser till he gain skill by experience.

But perhaps some one would like to ask me how old George will be by the time he gets a farm of his own by this process. Perhaps the heart of the young man is saying to me, "Do you expect me to work and wait, and to keep Lucy waiting, all these years before we begin the business and enjoyment of life?" My answer is that it is one main part of the business of life, and one essential condition of its best enjoyment, to make all necessary preparation for living well. It is thought by some to be a great advantage of the farmer's life that it encourages young people to marry early and gives them the means of a comfortable maintenance. Perhaps this is so; I certainly am not wise enough to maintain the contrary. But let it not be disguised from the young people that if early marriage means a narrowing of the preparatory stage of life, then their whole life must be in the same proportion narrowed. For Lucy has much to do to fit her to fill, enjoy and adorn her position as a farmer's wife. That their minds may grow together under the enlarging and educating influence of their common calling, she too must have been educated up to the capacity of growth—which is really the best result and the test of all education. In all other callings a long apprenticeship must be served before one can set up for himself; why should those who are going to be farmers, those, I mean, who aspire to make the most of themselves as farmers, take less time for preparation than others? George will begin to farm for himself by the time he is twenty-five years old, and will have earned his own living several years before that, and this is as soon as his brothers, who are going to be lawyers, doctors, ministers or merchants, will be able to enter fully into their professions. And if he is to be their equal in every respect, as I desire that he should be, their equal intellectually and

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socially, with as good a chance for all the innocent good things of life, public respect, influence, position, office, he must take the same means and make the same exertions to secure them as they do. A visit to our state legislature is full of instruction on this point. Of the members of the house of representatives, a large majority are always farmers. They are, in a sense, picked men, not the very wisest of their class in the state, but above the average. Any twelve of them taken at random would make good jurymen. On matters which have come within the range of their observation and reflection, the local interests of their school districts towns and churches, they are competent to judge soundly. But, remembering the respect always due to our rulers, I shall content myself with saying that on many of the larger questions which come before them, they are not competent to form an opinion, and none are more aware of it than themselves. Timid from inexperience, unacquainted with the arguments for and against the measures proposed, unaccustomed to debate, novices in those parliamentary methods by which measures are carried or defeated without regard to their merits, they are, for the most part, silent, uncertain of their own opinions, usually conservative but not proof against the impulses which sometimes carry them into hasty and ill-advised measures. I am not complaining of the legislature because it is so largely composed of farmers; a state so thoroughly agricultural ought to have a legislature largely composed of farmers. Neither do I intend to speak disparagingly of these men. They are, in the main, estimable men. Some of them are in native endowment superior men. They went from the common school to the farm, and there they have been ever since, leading a laborious, honest, useful life, as intelligent as men well can be who have had few opportunities of enlargement. The question is not about them; they grew up when the means of education were remote and difficult. The question is about their children, whether or not they shall have a better outfit for life. The question is, when George shall be elected to the legislature, what sort of a member will he make? I want to have him so trained that when his brother, the lawyer, who may be chairman of the judiciary committee, presents his view of a question in a close, subtle argument adapted to bewilder those whom it does not convince, George, the chairman of the committee on agriculture, can rise in his place, if need be, and in a straightforward, manly, masterful way, with the eloquence of a trained speaker and the dignity of an honest farmer, show the fallacy of the argument and bring the house over to his side.

When that time comes, when the farmers are as well trained and

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every way as accomplished men as their brethren in the professions, then once again when the state needs the services of her best men, when great emergencies arise which call for the highest wisdom and valor, all eyes will instinctively turn toward the men who are holding the plow or digging in the cabbage-field, for the leaders and dictators whom the hour demands.

I know too well what answer many will make to all this: "The education you describe is something very fine, but it would turn our children into gentlemen and ladies, whom we might have the privilege of waiting on. Education weans boys from the love of work, and our boys must work, as we did. Your scheme is not practical. It may do for the sons of a few rich farmer, but the majority of boys are better off with a good common education and plenty of work." Are the farmers of Vermont, then, a peasant class, to whom education is to be denied, and denied by themselves, lest it lift them out of the station in which it has pleased providence to place them? Is education something too good for them, something fit for their betters but not for them? I have not read aright the history of Vermont if any such spirit as this is native to the soil. I believe that nothing God has to bestow on his most favored children is any too good for Vermonters, or for farmers. If education will make gentlemen and ladies of our children—and education and religion certainly will—there is no place where true gentlemen and ladies have a better right to live and reign and multiply their kind than on the farms and in the homes of Vermont. And if there is any good thing in life which we failed to get for ourselves because we came too early in the course of human progress, let us do all we can to secure it for our sons and daughters. There was one in history who thought it more glory to be a king-maker than a king. Let the farmer who is uneducated himself, and has felt his deficiencies, get his compensation in giving superior advantages to his children.

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A MORE THOROUGH SYSTEM OF TILLAGE REQUIRED.

By E. R. TOWLE, West Berkshire.

Prominent among the wants of agriculture to-day is a more thorough system of cultivation. Different methods are required now than were practiced by our fathers when the country was new. Then the soil was in possession of all its original fertility and richness, the accumulation of centuries, resulting from the growth and decay of vegetable matter, while besides, the surface of the ground for a considerable depth was penetrated in every direction with the roots of plants and trees, that not only in their decay furnished nourishment for the cultivated crops that were to follow, but acted mechanically upon the soil, keeping it in a loose and pliable condition, answering in a considerable degree the purposes of drainage and supplementing, if we may say, the work performed with the very rude and imperfect implements and tools that were used at that time.

If attention is paid to the matter it will readily be seen why the early settlers, those who cleared their lands of the original forests, raised generally such bountiful crops with scanty and imperfect methods of cultivation. The soil was full of richness; it had not been depleted and run out by long continued cropping or careless management, but contained in itself all of those elements that were needed for the growth and maturity of excellent crops of most of the kinds that we now raise. What crops of corn and wheat and potatoes; of oats, rye and hay were grown among the blackened stumps and log-heaps, where no plow had ever turned a furrow, and it was with difficulty the rude harrow could be used, yet these crops grew, the roots luxuriating in the rich mould below and sending up the stalks and branches that bore a wonderful harvest, making the blackened landscape smile and the farmer's heart rejoice.

No weevil and rust then; no blight nor insect pest; no potato rot nor Colorado beetle; no anxiety about manures or patent fertilizers; —these are the portions of the farmers of to-day, and not of those of that long time ago. For years the implements of husbandry were poor and inadequate for the work to be performed; still good crops were harvested until the primal richness of the soil became

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in a measure exhausted by the imperfect surface cultivation, and more thorough methods were sought out. The improvement in farming implements and tools has been most remarkable within the memory of the present generation. It would be nearly impossible now for farmers to raise fair or medium crops with the utensils that were used forty or fifty years ago, as from the present condition of the soil a much more thorough cultivation would be necessary in addition to the manure that is usually applied.

Think of turning up a field with a wooden plow shod with straps of iron, harrowing with a wooden-toothed harrow, cultivating the corn and potatoes with one of these plows or a home-made harrow, and doing the hoeing with a clumsy, heavy iron hoe. These were the tools used by the pioneer farmers of these towns, now and then one of which may still be preserved as a relict of the olden time, but most are gone; gone with the serried array of blackened stumps that scarred the landscape all around, "tally-marks" of the pioneer farmer's toil. One generation rests upon these hill-sides, another is fast passing on toward that bourne from which no traveler ever returns, while a third is coming upon the stage of action. May the graves of our ancestors ever be cherished and may God's blessing rest upon the descendants who stand in their places and with united efforts strive to retain, to build up and beautify the farms and homes of our beloved Green Mountain state.

As the stumps and roots were removed or decayed in the ground, and the process of cultivation went on year after year, the soil became more compact and firm, the large amount of vegetable matter gradually disappeared, and necessity compelled the farmer to the exercise of more ingenuity and skill in his occupation, in order to realize adequate results from his toil.

Notwithstanding the great improvements that have been made in farming implements and machinery, by the use of which a better and more thorough system of cultivation should be the result; yet the progress made in this direction has not been what it should be, nor what might be expected under the circumstances. With all that we can lay claim to in this direction, and the amount of fertilizing material that is yearly produced upon the farm, there is an impression prevailing to a greater or less extent that our lands are deteriorating—in some cases slightly, in others more perceptibly, and that something must be done to counteract this tendency to depletion, or exhaustion and poverty will be the result.

Allowing that our farmers are making all the manures that they possibly can, or that they will do this in the future, I wish to call

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attention to the importance of a better system of tillage or a more thorough cultivation and working of the soil, as one means by which larger crops may be raised and the mechanical condition of the soil improved.

Plowing is the basis of good cultivation, and the ease, rapidity and thoroughness with which the last can be accomplished, will depend in a great measure upon the manner in which the first is performed. And here I would say that plowing is an art of itself, something that must be learned before it can be properly performed. It is not every man that can plow well, far from it; it is a kind of labor that requires good judgment, skill and dexterity.

First, a word about plows. It must not be expected that one plow, however good, will be sufficient for all purposes of the farm, or that the same plow is alike adapted to all kinds of soils; if so, here is a mistake that needs to be corrected at once. There are a great variety of plows made, of all shapes and sizes, and of different materials, adapting them to all kinds of land and work. If a farmer's soil is light—sand or gravel—he needs a plow with a different shaped mould-board from his neighbor, whose soil is clayey and stiff. One kind of plow is better adapted for breaking up green-sward than working in old ground, and the opposite may be said of another.

Good judgment is needed in the selection of the right kind of plow for the particular work that is to be performed, and the farmer should understand his position well before purchasing. A good plow may not work well at first if not properly adjusted, hence the farmer needs a mechanical eye.

The plow should be gauged to run straight and true, cutting a furrow of the right width and depth, and requiring but little effort to keep it in a proper position. The evener, whiffletrees and driving lines should also be correctly adjusted, and thus rigged, with a good team, excellent work should be accomplished, provided a workman has hold of the handles, but no sane man would send such an equipment as this to the field in charge of an ignorant laborer or boy and expect good work. If the field is free of obstructions, with a little practice and careful management, fair work may be accomplished; but alas, I say, how seldom is this the case in this state. A large portion of our meadows are stony, presenting serious obstacles in the way of the plow and requiring a great deal of patience on the part of the operator to perform creditable work.

Of course the enterprising farmer will not follow the practice of turning under a crop of stones every time he plows, but will keep

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them well removed, and I believe it would often pay to have a man follow the plow and throw out upon the surface those that become uncovered and loosened in the furrow. But after the best that can be done under the circumstances, still there will be many stones or other obstructions in the ground, and the plow will often be brought to a sudden halt or thrown out of the furrow, and if care is not exercised bad work will be made. Sufficient care is not generally exercised in plowing; if obstructions are in the way, they are lightly passed over, frequent baulks are made that will interfere with the work of the harrow, and the field is left scarred and uneven. If a farmer does not perform this work himself, he should see that it is done properly. Some plows leave the furrows in a light and partly pulverized condition, and are to be much commended for this feature.

Where fields have been plowed of a uniform depth for a long series of years the ground underneath the furrows will gradually become more compact and hard, interfering with the passage downward of water, holding it as in a basin, and preventing that full development of the roots of plants, sown or planted, which a more thorough working of the subsoil would assist. In such cases there is no doubt that plowing a little deeper once in a while, breaking up this substratum of earth, would be beneficial, as it would not only deepen the soil, allowing the plant roots to penetrate downward, but also bring to the surface mineral matter that is of value to crops. There are many instances where lands, and especially light soils, have been plowed somewhat deeper than usual with great success, but this practice should be followed cautiously, as the bringing upon the surface of too much subsoil at one time has been attended with considerable injury to the land.

We do not plow enough. If greensward has been well turned over, either in the fall or spring, perhaps there need be no occasion for plowing a second time before seeding, but with old ground the case is different. If this was plowed in the fall and cannot be planted or sown until somewhat late in the spring, the soil will become compact and hard, and unless much pains is taken will be loosened and pulverized only to a little depth, furnishing a very shallow seed bed. It would be much better to plow such lands again in spring, unless a deep-cutting harrow, like the Randall, is used. In some European countries men follow plowing as an occupation, and in this way become very expert in the business; it is not so here; the farmer is expected to do all kinds of work, and perhaps does not in this way become as proficient in any one branch as he should.

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But we contend that the farmer should know how to plow and how to do it well, and that he should insist on its being properly performed by his workmen, and especially that the boys be early trained in this art of husbandry. It is not a menial occupation, but one that is honored and ennobling, one that has claimed the attention of some of our greatest men. Burns composed some of his poems while following the plow, and we once read of a noted farmer saying that he could arrange an agricultural address with good success while engaged in this operation. Let no one despise this labor, but remember that

"He who by the plow would thrive,
Must either hold, himself, or drive."

If the plowing has been properly performed the after cultivation will be comparatively easy, and there will be no difficulty in making a good seed bed, but if this is not the case no amount of harrowing will compensate for this deficiency.

We harrow and cultivate for the purpose of loosening up the soil that has been inverted by the plow, pulverizing it and making it fine and mellow for the reception of seed. It should be understood that the seeds sown or planted, many of which are very small, cannot germinate and grow with any degree of certainty or thrift in a hard or compact soil, or where it is but imperfectly pulverized and full of lumps. The small, fibre-like roots of the plants seek to spread around and down into the earth in search of nourishment, and the finer and more mellow the soil the better will this be accomplished and the more robust and healthy will be the growth. The roots of these plants obtain their nourishment from the soil and fertilizers applied, not in a solid but in a liquid form, hence the necessity of making both the soil and the manure as fine as possible, so that the fertilizing properties which only can stimulate growth and development, may be the more easily and quickly appropriated.

The harrow follows the plow in its work upon the farm and is hardly second to it in importance. Its object has been specified and we wish to impress upon all the necessity of using this implement much more than we do. We do not harrow our ground one-half enough. We are in too much of a hurry to get the spring's work done, and are more anxious about this than in performing it in the best manner. We want less of surface work and more of getting down to the bottom of the furrow. If the old spike-tooth will not do this—and it will not—then get some other kind that will, as the Share's, LaDow's, or Randall's. These will go down to the root of things, will cut up and pulverize and make fine the furrows and the

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manure, mixing it well with the soil, especially the two latter, which is what we want. This thorough working will also help to unlock the store of plant food still in the earth, but hitherto in an unavailable form, and bring richness to the surface transforming it into fruitful harvests.

There is an old saying that "tillage is manure," and it has been proved true in very many instances. Lawes and Gilbert of England have raised barley upon the same land for twenty-six consecutive years without manure, obtaining always the same yield, simply by thorough cultivation. Many farmers have taken apparently worn-out land and pursuing a different and more elaborate system of cultivation, often with no manurial resources beyond the farm, have achieved wonderful results. Is it too much to state that if we expended twice the present amount of labor on our land in cultivating crops the yield would be increased one-fourth? I think not. Then is there not here a stimulus to exertion, an aid to the manurial resources of the farm that is worthy of our most serious attention and consideration?

Before leaving the harrow, I would say that hardly any one kind is sufficient for the wants of a farm. The wheel harrows cut and pulverize the soil deeply and well, mixing and covering the manure in excellent shape, but they do not smooth and level the field as much as is desirable and will cover too deeply the wheat, oats, and small seeds; and in addition the farmer should have a fine-tooth or smoothing harrow, when with the two all kinds of work can be well and properly done.

I would not omit to mention the roller as most useful upon the farm, in smoothing the fields after seeding to grass, in flattening down the furrows of greensward previous to harrowing, pulverizing manure, etc. If an attachment for the sowing of grass seeds was used, considerable time and labor would be saved and a more uniform distribution secured.

Thus far my remarks have been confined to the preparation of the soil for sowing or planting, and one word more before I proceed. We should never work our land, if possible to avoid it, when wet and heavy. I am confident that bad effects have often resulted from this practice, and the yield of the crop has been seriously diminished, sometimes nearly ruined, from this cause alone. We had better wait a little longer before plowing our land or putting in our crops than to do this when the ground is wet and heavy. This condition of the soil shows a great want, and that is drainage. On most of our farms a thorough and perfect system of cultivation cannot be

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fully carried out until attention is paid to this matter—indeed, we may well term it a prerequisite of good husbandry. But the limits of this paper will not admit of elaboration upon this point, for it for it would well form the foundation of a most exhaustive article of itself, and should be thus treated.

But after the most thorough preparation of the soil for the crops, and after the seeds have been sown or planted in the best manner, the process of cultivation does not end. The proper care of the planted crops require much labor and skill for their best development and most profitable returns. If the previous preparation, of which mention has been made, is thorough and complete, the after cultivation will be proportionally easy and satisfactory, but this must be well attended to and in its proper season, for the finer and more mellow the soil is kept, the greater will be the growth of the plants, the more healthy their condition, while the weeds will not have opportunity to put in an appearance, much less to make a growth or mature their seeds, robbing the land of its richness and laying up in store labor and perplexity for future years, for you know the old saying that, "one year's seeding makes seven years' weeding."

Then let us not forget to cultivate the corn, the potatoes and root crops thoroughly and well, without regard to the number of times this work is done, performing all that we can with the horse and the best implements that we can obtain for the purpose.

In many sections of this country when the plants are small this work is easily and expeditiously performed with light smoothing harrows, having backward-slanting teeth, taking a wide sweep broadcast over the fields of corn and potatoes, destroying the newly starting weeds but not injuring the plants. This practice is frequently followed out upon the fields of corn, keeping the surface clean and mellow until the plants are six inches high, when the cultivator and hoe are then used until the growth becomes too great for their work. This practice of cultivation may be new to some, yet it is successfully practiced by many farmers.

But I need not pursue this subject further. It is perhaps necessary to re-state that the more labor and attention we bestow upon our soil and crops, the better and more satisfactory will be the results; or that, if following out a more thorough system of culture we can thereby add to the fertility of our farms, supplement our manurial resources, turn the tide of deterioration into one of improvement and progress, stop the cry of "our farms are running down," we are achieving a success well worth the labor of working out.

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SUGAR FROM CORN, BEETS AND SORGHUM.

Not a little interest is manifested in the experiments already made and those yet to be made in providing the necessary amount of sweet for the millions of our country from materials so familiar and common as corn, beets and sorghum. We feel that the greatest amount of gratitude and aid is due to those men who are trying to establish this as not only among the possibilities, but as a profitable and valuable enterprise.

Professor Collier expresses the hope that the matter will not be dropped, in Vermont, until the feasibility of the same is established, as he is very sure it will be in the near future, and that his experiperiments this year, with corn especially, confirm and strengthen his previous ones.

The effort made by Mr. N. B. Safford of White River Junction with sorghum, under the auspices of the state agricultural society, was a failure, owing, so far as we can now see, to the early and protracted drouth, the seed failing to germinate, having been sown with a common seed drill which did not cover it to a sufficient depth. Mr. Safford writes that of the seed he distributed, "Mr. J. O. Johnson of Norwich, Vermont, raised seventeen square rods of very good sorghum stalks, growing nearly or quite ten feet tall, and from this growth he procured seventeen gallons of syrup, weighing 11 1-2 pounds to the gallon. The stalks were crushed with temporary wooden rollers and they estimated that fully 20 per cent of the juice remained in the stalks.

"J. W. Sanborn, Esq., superintendent of the New Hampshire state farm, raised nearly the same amount of sorghum, which was worked at Mr. Johnson's with nearly the same results.

"Mr. Johnson is so well pleased with the result of his experiment this season that he proposes next year to raise a number of acres o[illegible]

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sorghum, procure better machinery, and give it a more thorough trial."

Mr. Sanborn of the New Hampshire state farm has, we believe, raised several acres of beets this year with fair success, selling them to the Portland sugar manufactory.

Professor Dole, of Norwich university, has also been making some experiments with corn. We subjoin his short account:

CORN AND SORGHUM FOR SUGAR MAKING.

In view of recent developments in making sugar from corn and sorghum, it would seem that we have here in Vermont a new product which may be successfully utilized for this purpose. Professor Collier, who is deserving of all praise for what he has done in this direction, is very sanguine of success. Hearing his lecture in Montpelier last winter, I determined to try, in a small way, if sugar could profitably be made from corn. These experiments have not been very extensive, but the results certainly justify further trial.

I began my experiments with corn just at the time the ear began to form, and they were continued till the corn was ripe. Trials were made with Sanford, sweet and common yellow corn. The quality of syrup was about the same from all. But the stalks of the yellow corn were so small that I did not find them profitable to use. The quantity and quality from Sanford and sweet corn was nearly the same. It must be remembered that these experiments were not carried on with that degree of exactness that a chemist would have used in his laboratory; the idea being to do the work in the simplest manner and in a way that any one can easily follow.

The process of making which I used is as follows: The leaves are stripped from the stalks, which are then run between the rollers expressing the juice. Lime is now added in sufficient quantity to neutralize the acid present, which may be known by dipping in a piece of red litmus paper. The juice is now allowed to stand a few minutes when it is poured into the kettle or pan in which it is to boil, care being taken not to disturb the sediment at the bottom. As soon as it begins to boil a thick green scum will rise, which is skimmed off. It is now boiled down as rapidly as possible to the desired consistency.

I did not enter into all the details of manufacture as given by Prof. Collier. I added sulphurous acid in a few cases to neutralize

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any excess of acid, but found no advantage in it, though it might be found beneficial in other cases.

I used some of the amber sugar cane (sorghum) furnished by Mr. Edwin House of Waitsfield. It is sweeter than corn and in the cases tried made a little better quality of syrup. The sugar made from both the sorghum and corn was thoroughly tested for cooking purposes, and found to be superior to any found in the market.

Which will be found the more profitable to grow, corn or sorghum, I am unable to state. There is one advantage in favor of the corn—the stalks, after the juice is pressed out, make a good fodder, and it can be easily dried and packed away like hay. The refuse from the sorghum my cattle would not eat, although horses seemed to relish it. Another thing in favor of corn—the ears can be ripened sufficiently to cure, be taken off and the stalks used for sugar.

Of the kinds of corn for this purpose I am inclined to think the Sanford the best, all things considered, for Vermont. Further experiments are necessary to determine this to a certainty. As to the amount of sugar that can be made from an acre, I cannot say, but I made at the rate of fifty gallons of syrup to the acre from Sanford corn after the ears were taken off to dry.

It seems to me that we have here a new and what will prove to be a profitable field of industry. It is certainly worthy of the fullest investigation, and I hope that measures will be taken another year to give it a full and fair trial under the most favorable circumstances. For this purpose the concerted action of a number of farmers would be best, as they might, at very little expense to each, get all the necessary appliances, and the probabilities are that they would be well repaid.

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VERMONT AS A HOME.

By Hon. ALBERT DWINELL, Calais.

J. B. Mead, Superintendent of Agricultural Affairs of the State of Vermont:

My attention was recently called to an article published in the Rutland *Herald and Globe* of August 28th, entitled The Future of the Vermont Farmer, which in my opinion ought to meet the rebuke of every loyal Vermonter. I am surprised that such an article should appear in one of our state periodicals, and much more that it should be written by any one who may have had the pleasure of a home among the green hills, and enjoyed the blessings of our institutions.

The writer must have been in a fit of despond, for he sees nothing for the Vermont farmer but continuous hardship and general depression of agricultural civilization, all because railroads have penetrated the far west and opened fresh fields and pastures new. In proof of which the writer states: "Thirty years ago central New York was a wealthy wheat-growing region; to-day the vast system of railroads places western wheat and flour in the eastern markets at so cheap a cost that fruit-growing and dairying are the leading industries of the farmers in the middle states, and in Vermont dairying is about all that is left to the farmer, and the west will eventually wrest all the profits of that industry from our hands, for every year sees the hold of the east on its old-time employments of agriculture and dairying relaxing, as new railroads are built and transportation rates are simplified and reduced by the emulation of the Grand Trunk lines. * * It is getting worse every year, with no prospect of getting better. * * And that this threatened usurpation by the west of the dairying interest, that for several years has been all that was left to the farmer of the middle and New England states, will be a blow severely felt in a hard, poor state like Vermont; for outside of the Champlain valley and a small strip along the Connecticut river from Barnet to Brattleboro, Vermont is a very poor state. The valley of the Otter creek is a fertile tract, and there are some fine intervals lying along the Winooski and Missisquoi rivers, but the rest of Vermont is so poor that it

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would have been better for the state if a number of the mountain towns had never been cleared for settlement, but had been left to grow up to forests." The writer further states: "It it more likely, with the decay and desertion of our Vermont farms that is taking place, consequent upon the increasing emigration of our young men to the west, that some towns in Vermont will be eventually remitted to the solitude from which they were rescued, for the energetic, ambitious and enterprising natives will not be content to stay and barely eke out a living in Vermont when the luxuriant wheat fields of the west beckon them thither, and during the next 10 years we look for a large emigration from the Vermont farms to the west and consequent increasing signs of decline in agriculture and farming industries throughout all our coasts. The situation is not the temporary result of hard times that has followed the panic of 1873 and the shrinkage in value incident to the passage from inflation to hard pan and resumption. It is a permanent change in our civilization that was inevitable the moment that the railroads reached the uttermost parts of the west and solved the problem of quick and cheap transportation to the east of agricultural products." * * *

Had the above article been written in the interest of some railroad enterprise or in the interest of colonizing some western state or territory it might be looked upon with some degree of allowance. But emanating as it does from a a rich agricultural section, it cannot do otherwise than foster a spirit of discontent, which would be detrimental to the best interests of the state. Is it true, because New York was once a rich wheat-growing state, that her agricultural products are less remunerative, because there has been developed to them the resources for an interchange of products? Is it true, because farms near large towns and cities have been converted into vegetable and fruit raising that they are less remunerative? Is it not true that the rapid increase of the inhabitants in our country and corresponding growth of towns and cities open new markets and demands which will inevitably change the base of agricultura products, for the governing principle of the farmer is to devote his lands to such products as will bring to him the most profitable returns? That instead of the farming and general interests of Vermont being depleted by the great railroad system, it has opened to us markets both home and foreign which are avenues of wealth to the industries of the state. By it Vermont marble to beautify and adorn finds its way to distant parts of the country. By it we find blooded stock of Vermont improving the herds of sheep and cattle

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in the south and far west. And by it our products are made available to the demands of the larger markets.

Articles like the above, berating and speaking in the most deplorable terms of the prospects of farming in our state, can but have a tendency to create and foster a feeling of discontent with the people of the state, especially with the young and enterprising who are not established in business. To those who may have been influenced to believe that Vermont is a poor, hard state, and that there are but a few localities worthy the attention of the agriculturist—to such it might be well they should go and traverse the country between the Mississippi and Missouri rivers, thence into Nebraska and Kansas, or over the rolling, grazing regions of Wyoming and Colorado, thence across and down the Sierra Nevada mountains, into the broad valley of the Sacramento. When they have learned the customs, habits, advantages and disadvantages of these localities, they might be led to look back to the old Green Mountain state, with her mountains, lakes and rivers, her towns, churches and institutions of learning, with her fine cottages and farm buildings, and behold more happy homes and contentment than they have been able to find in the west. In recent travels in California and the west, and observing their ways and habits, I was led to the conclusion that if the people of Vermont would deprive themselves of the comforts, luxuries and pleasures of life that the farmers and workingmen of those localities adopt, we should hear very much less about hard times and of farms going back on mortgages.

While the writer foreshadowed the doom of the agricultural interests of the state by usurpation and poorness of her soil, and has alleged that the farmer young enough to succeed in a new country has nothing to hope for in Vermont and must go west, if he is obliged to cut his own fodder, rather than toil terribly in Vermont to be undersold by the west; notwithstanding such allegations we have evidence to believe the productiveness of Vermont soil is more than an average with that of the west, and that the value of her crops per acre are more; as is shown by the following, taken from the report of the commissioner of agriculture for 1878, showing the average cash value per acre of the principal crops of the farm taken together for the year 1878:

Vermont,.....	12.24
Illinois,.....	7.68
Minnesota,.....	7.76
Iowa,.....	5.80

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Kansas,	7.58
Nebraska,	6.55
Wisconsin,	9.77

Thus it will be seen the value per acre of Vermont farms largely exceeds those of the states mentioned and is in excess, on the aggregate, of 65 per cent. It is said it costs more to raise crops in Vermont; that is true, but the extra expense is largely owing to the expense of keeping our farm lands up to a full standard of productiveness, while the lands of the west are constantly decreasing by constant cropping. Vermont is rich in grandeur and beauty, her soil is fertile, her institutions are unsurpassed, and her resources, both developed and undeveloped, are inciting the enterprise and wealth of the state.

That the interests of the state suffer in various ways is admitted. Our style and customs are not in accord with paying debts. Perhaps there is no one feature by which the general interests of the state suffer more than by the present oppressive, irregular railroad tariff. For example, I quote the sayings of H. E. Alvord of Easthampton. At a recent agricultural meeting in Massachusetts he says: "Last fall I saw a refrigerator-car load of butter arrive in Boston from Iowa, over the Canada route, which cost the shippers only 60 cents per hundred weight for transportation, with no charges for ice, while by the same train came a load of butter from Vermont in a common car, its condition soft and unsatisfactory, the freight rates varying from 80 cents to $1.00. These two lots of butter were equally good at home, but on arriving at market the one that cost most to get there sold for less than the other."

He further states, "the Boston & Albany railroad is largely owned by the state, yet the cheesemakers in Berkshire and Worcester counties, part owners of the road, are compelled to pay four times as much to carry a ton of their produce to Boston as is paid for the same weight of Wisconsin cheese carried over the same rails."

What is true of Massachusetts is true of Vermont, and what is true of dairy goods is, in a degree, true of all kinds of farm products sent by rail to market. That the people of Vermont should suffer such great injustice, and be shorn of what would seem to be their constitutional rights, is lamentable, and will be endured until the people, who are the rightful sovereigns, shall, by their united influence, correct the wrong. The farming of Vermont, if given a fair field, will hold its own with other states, but it can't bear the com-

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petition it must meet when such advantages in transportation are given competitors by home roads.

Our present mode of executing the listing laws of the state is very irregular, and is oppressive to the class that should be most favored. When such wrongs shall be corrected and the people are led to see that it is the abuse and not the use of railroads by which we suffer, then, and not till then, may we expect to see the state developed to that high standard to which her resources entitle her.

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THEORIES AND METHODS OF SETTING MILK.

By O. M. TINKHAM, North Pomfret.

In no branch of agricultural industry has there been shown more interest, more careful experiment and thorough research in the last ten years than in that of dairying—the management of milk and its products.

Being a "butter dairyman," I shall attempt to discuss only that branch of the subject, and the object of this paper is to gather and put on record most of the methods now in common use for getting the cream from milk for the making of butter.

From the earliest times with which we are acquainted, it has been the practice to set milk in small, shallow vessels in a moderate temperature, where it remained from 36 to 48 hours for the cream to collect on the milk, when it was skimmed off and churned at proper intervals.

These pans, within the period of my recollection, were almost entirely of earthen ware, and tin pans were looked upon as yielding less cream from the same milk, and probably correctly so, as metal is a much readier conductor of heat than the earthen ware. While these vessels were almost wholly in use, there were localities, especially south, in which the milk was set in "spring houses," in deep "crocks" in the cold water.

The setting of milk in small tin pans is still practiced in many of the smaller dairies of Vermont, and by some of the best dairymen of the state who have larger dairies; and it may be questioned whether, in a favorably located dairy room, and in the most favorable season, more or better butter can be made by the skilled dairyman by any other method, though under less favorable conditions the product by various other methods must be more, and in any case the saving of labor very great.

The first considerable changes which we recall were the "Jewett pan" and the "Orange county system." The first was a pan about

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six inches deep, and of sufficient size to hold the milk from one milking of the herd. Four of these pans were required for a set, and the milk was allowed to stand 36 or 48 hours, as desired.

This pan had a second or false bottom, with a space between them through which cold water was made to flow, with the idea of securing a lower and more even temperature in hot weather, or hot water was poured in in winter to raise the temperature.

The Orange county system used cans of about 20 inches depth and eight inches in diameter, which were set in wooden tanks as they were filled with milk and the tanks filled with cold water, which came up outside the cans as high as the milk inside. Mr. F. D. Douglas of Whiting varied this somewhat, using pails of the ordinary size, about 12 quarts, used substantially as described above.

The next step in pans was the making of a second pan, in which the milk pan was suspended, leaving a space around the sides of the pan as well as under the bottom, and cold water was made to flow around as well as under the milk pan, which gave more cooling surface and improved its application. There were various patents of this idea, varying chiefly in devices for utility and not differing materially in principle.

The next device for public favor was a startling one. Heretofore it had been universally accepted as fact that milk must necessarily stand at least 36 hours to get all its cream; that it should have a certain amount of light and free ventilation that all animal odors might pass off.

The Cooley system, brought out by Mr. William Cooley of Waterbury, and made by the Vermont Farm Machine Company of Bellows Falls, boldly took the ground that there were no injurious or offensive odors in the milk of healthy cows properly fed; and his cans, 9 inches in diameter and 19 inches deep, when filled with milk were covered loosely by an inverted pan, the cans set in an iron-lined, wooden tank, the covers fastened down, and then the tank filled with cold running or ice water, completely covering the cans. A better idea of its appearance may be had from the cut following:

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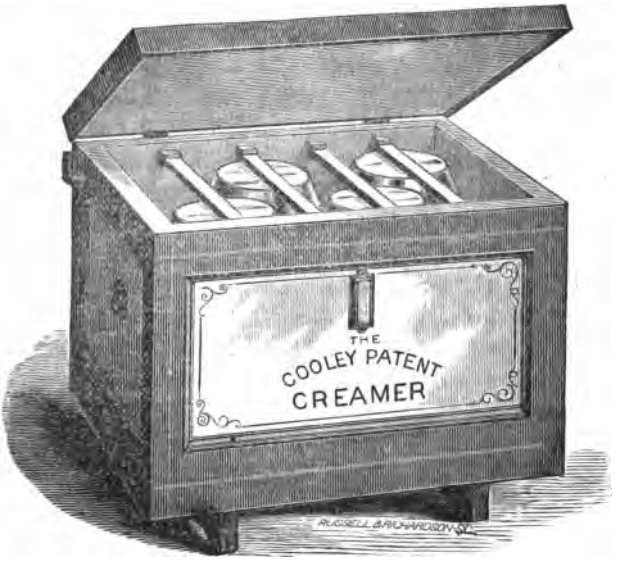

The whole kept at a temperature of from 40° to 45° is expected to completely separate the cream from the milk between milkings, when it is skimmed (by drawing the milk from below the cream) at not longer periods than 12 hours, thus making but one set of cans, or enough to hold one milking of the herd, necessary.

The sectional view of a can in the tank will give a clear idea of its operation:

The theory of the Cooley system is, that milk should be cooled from all points of contact; that cold setting prevents the developing

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of offensive odors, and that such as may be present are readily absorbed and held by the water, which prevents the contact of the surrounding atmosphere. Their apparatus has been improved in utility and ease of management, but its principles of construction have not been changed.

About this time Mr. D. B. Wooster of Marshfield brought out a milk-setting can of different design and constructed on a different theory of the proper handling of milk. Mr. Wooster believed that milk should be cooled from its upper portion only, and his can, of about the size of those before named, had around it, a little above the middle, a cup-shaped rim, giving the can the appearance of having been set through a hole in the bottom of a ten-quart pan.

Through this rim or channel about the can cold water was kept flowing, or ice placed, thus cooling the milk at the upper part, the theory being that the watery parts of the milk acquire a greater specific gravity as they cool, move downward, and thus force up the milk in the lower portion of the can, which in turn moves downward again, till all is equally thoroughly cooled; while the butter globules, less affected by the low temperature, rise with the milk, or of their own motion, and remain at the top.

WOOSTER'S PERFECTION CREAMERY.

Mr. Wooster afterwards built a creamery on this principle (shown above), the cans being fastened in the bottom of a tank at about their middle, while the lower portion hangs in the ordinary temperature of the cabinet below. The tank above is filled with cold water or ice water, while gauze-covered tubes in the cover admit of free ventilation.

In this creamery the milk is drawn from the funnel-shaped bottom through a faucet, by which it is claimed all sediment is carried away with the milk.

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MOSELEY'S CABINET CREAMERY,

(Moseley & Stoddard, Poultney,) might, from its general appearance, be taken for the Wooster by a careless observer, but it differs from that materially, and is constructed upon a different theory.

The theory of "currents" is discarded in the Moseley, and the milk is cooled the length of the can; the can appearing through the open doors of the cabinet above not being the milk can, but a larger one in which the milk can sets, leaving a space of about half an inch between the two for the ice water, the theory being that less ice will be required to bring the temperature down to the desired point where there is so small an amount of water to cool, while cooling from the entire surface of the can with which the milk is in contact.

In this can the milk is drawn from the bottom through an "illuminated faucet," which shows when the cream approaches the outlet. These cans are readily removed for repairs or any other purpose, when desired, by unscrewing a rubber-packed nut on the bottom of the can which holds it in place and makes it water-tight.

Another Vermont invention is

FERGUSON'S BUREAU CREAMERY,

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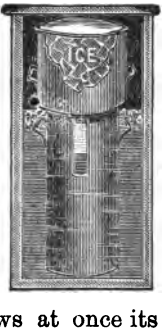
(Ferguson Bureau Company, Burlington). This differs materially in theory and construction from the deep, cold and half-cold setting systems before described. This, as the name indicates, is a "bureau," the drawers of which are milk pans, with a space above for ice and one below for the cream pail, etc. The pans are of such size as to hold one milking of the herd, and thus four pans are required, and the milk stands from 36 to 48 hours. The pans placed as shown in the cut stand on rollers, an adjustable track is placed for the pan to be used, the pan rolled out for the milk to be strained into it, then rolled back into the bureau and the door closed.

Mr. Ferguson believes milk should stand 36 hours to make the best butter; that air of about 60° is the best medium for its setting and cooling, and his apparatus was made to give good "June weather" the year round. A pipe running through its lower part covers at one end, outside the bureau, a kerosene lamp in winter which gives sufficient heat to maintain the desired temperature. The cream from this method more resembles that of the large open pans first named, being of thicker consistence and much less in bulk than that obtained from deep, cold setting, because of the much greater exposure of surface and less depth of milk and longer standing to obtain a more perfect separation. These, so far as we know, comprise those methods in general use which are the product of Vermont genius and experiment.

The "Hardin system" is an adaptation of the Swedish system, by L. S. Hardin, Esq., of Kentucky, and in this deep cans are set in a cabinet and ice placed above them.

Another cold setting can is the Lincoln creamery, (W. E. Lincoln, Warren, Mass.,) a section of which we give below:



The cut of this can shows at once its operation and what is expected of it. Mr. Lincoln puts great stress on cooling the milk as rapidly as possible after it is drawn from the cow; so while the tank

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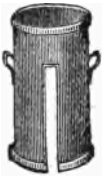
is filled with ice water a larger, shallower can filled with ice is used for a cover.

In searching for the greatest rapidity in cooling he hit upon another device by which, by slightly reducing the capacity of the can, he has secured about 200 square inches additional cooling surface, which is done by dividing the can for about two-thirds of its vertical distance by a channel of an inch in width, which is clearly shown in the cut below:



Mr. Lincoln's theory is that if the milk is not cooled at once on being set, before the cream rises, the cream covering the top of the milk will prevent the escape of heat upward from it, and twice the amount of ice will be required where the cooling process, going on more slowly, finds considerable of the warmth remaining after the cream has gathered and covered the top of the milk.

REID'S CREAMERY,

(A. H. Reid, Philadelphia.) Mr. Reid claims the discovery of no new principle in his creamery, using deep cold setting. His cans are different from any I have yet described, being 8 inches wide, 20 inches deep, and long enough to give the required capacity.

A gate fastened to a projection on one end of the can comes through one end of the tank where it is fastened with a screw cap,

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and may be readily removed. A small window shows the milk and cream inside the can and each can has a cover (shown on the lid of the tank), which shuts down over the can into the water, thus water-sealing each can. This creamery is compact and low, making it easy to strain milk into.

The Revolution creamery is somewhat similar in appearance to the Reid, having the same shaped cans, though thinner, and set the other way in the tank. The cans are hung in front on an iron rod and have a projecting lip or spout like the old-fashioned square spout of a strainer pail. When the rear of the cans are lifted by a handle made for the purpose, the lip projects over the edge of the tank and the cream runs off and afterwards the milk in the same way. The can being lifted quite out of the water, may be turned completely over, resting bottom side up to drain or dry.

I regret not being able to secure a cut of this creamery.

Another deep, cold setter, notable, not for its construction only, but as the basis of a new system, is the Fairlamb system, (Davis & Fairlamb, Chicago, Ill.) The cans are of uniform size, 17 1-2 inches high, 12 inches in diameter at the top and 10 at the bottom, with an arrangement for the cooling from the centre of the can as well as from its circumference, which is best shown by the sectional view we give:

Mr. Fairlamb's idea is to have the cans adopted by the dairymen of a certain section, and have a butter factory established whose agent shall visit the farmers twice a day and collect the cream.

Each can has a glass scale in front, graduated in inches, and each producer gets credit for just the amount of cream he has raised. The cans being of an uniform size and the milk set the same length of time, it makes a fair thing for buyer and seller, and no chance for

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the pump or skimming. Besides perfect fairness it has other advantages. It saves the transportation of the milk, which is left at home for calves or pigs, and saves the work of making and caring for the butter.

A decided innovation on all the old methods, and a novelty as well, is the Centrifugal machine for separating cream from milk by mechanical force. This method of obtaining cream was experimented on in Germany mor than 20 years ago, but it was not developed and perfected till many years later. The first one exhibited in this country, to my knowledge, was at the dairy fair in New York last December, and one has been in constant use on Mr. Edward Burnett's farm at Northboro, Massachusetts, for more than a year, and is probably the largest in the world, creaming about 2 tons of milk per day. This machine was made by D. M. Weston of Boston, Massachusetts, and its description will nearly apply for any one of these machines. It is constructed in all respects like a hydro-extractor, or a machine for taking water out of clothes, etc., except that the walls of the cylinder are not perforated.

Mr. Burnett's machine is an iron cylinder of about 24 inches diameter and 10 inches high, and a flange around the inner surface of the top which leaves an opening into the cylinder of about 12 inches in diameter. From this flange down to the bottom are ten floats or dams (like the dams on the inside of some barrel churns) to compel the milk to travel with the machine. Attached to the bottom and running down through boxes is a shaft with a pulley for a belt by which a rapid revolving motion is given it, when the milk is allowed to run in and separation of the cream soon takes place.

The process is very simple and, like most great inventions, easily explained. All dairymen know that the separation of cream from milk is the result of gravitation; the fat-globules being of less density than the watery portion of the milk rise to the surface. Now the Centrifugal machine produces a very powerful and forced gravitation, which develops the separation almost instantly and with great rapidity. At 120 revolutions per minute, a weight 6 inches from the shaft would be equal to $2\frac{1}{2}$ times its specific gravity.

At	600	revolutions	per	minute	equals	61 1-2 times its specific gravity.
"	1000	"	"	"	170	" "
"	2000	"	"	"	684	" "
"	3000	"	"	"	1537	" "

Mr. Burnett runs his machine at about 1500 revolutions per minute, and the pressure on the walls of this cylindrical basket is 200 pounds to the square inch, 50 pounds more than a government inspector requires on a new high-pressure steam boiler, so one can see

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that the best material and most thorough workmanship are required. The capacity of the machine at the speed stated is about 80 gallons per hour. The machine shown at New York was a "continuous" machine, milk running in and cream and skim milk constantly running out.

The following extract from Mr. Burnett's address before the American dairymen's association indicates very clearly the working of the machine, and the cream and butter he showed from it had a very fresh, sweet taste:

"On the 4th of last June, mixing thoroughly all my morning's milk, 704 pounds were run into the Centrifugal and yielded 35 pounds 8 ounces, or 1 pound of butter to 19.83 pounds of milk. This was churned in an old-fashioned barrel churn after 24 hours, at a temperature of 50°, and the butter came in exactly 17 minutes. Of the same milk, 660 pounds set 24 hours in deep pails immersed in water at 45° and skimmed very carefully by hand, yielded 32 pounds 4 ounces, or 1 pound of butter to 20.46 pounds of milk. This was churned after standing 24 hours at 60°, and it took 53 minutes to bring the butter. I wish to call your attention to the difference of temperature in the churning of the two different lots of cream, 10° in favor of the Centrifugal; and the length of time occupied with that cream only 17 minutes, against 53 of that from the pails. About these same results in favor of a slight gain for the machine were obtained from many subsequent experiments, but a neighboring farmer and butter-maker, who had rather laughed at 'Burnett's new-fangled machine,' after a good deal of persuasion on my part, this winter divided his milk, setting one-half, or 80 quarts, in small pans 24 hours, his usual method, and placed these in a cold, damp cellar at a temperature of about 55°. The other half in 10 or 15 minutes was separated by my machine and yielded 8¾ pounds of butter against 5¼ in the pans. Making a second experiment at my suggestion and using a tank and some of my deep pails with the same quantity of milk (80 quarts), he obtained 6¾ pounds of butter from the machine and 6¼ pounds of butter from the pails. He also found, on churning, a great saving of time with the machine-cream, which occupied only 11 minutes against one hour with the cream set in deep pails.

Wishing to try the effect of old milk I took, July 1st, and set a portion of the morning's milking, thoroughly mixed, in pails in a tank, the water at from 45° to 50°. The next morning, 24 hours afterwards, 165 pounds run through the machine, yielded 8 pounds, or 1 pound of butter to 20.62 pounds of milk; 126 pounds skimmed carefully in the pails by hand yielded 6 pounds, or 1 pound of butter to 21 pounds of milk.

As you will observe in all my trials there is a slight gain in favor of the Centrifugal machine over the ordinary methods, and the Germans with their repeated experiments have also invariably found a gain of from 3 to 6 per cent.

The cream obtained by this method is remarkable for its peculiar

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sweet flavor and smoothness. Running it off slowly, then cooling below 50°, it is even thick enough to cut with a knife."

After running off the last of the skim-milk we find a most offensive and greenish slime on the rear walls of the Centrifugal basket, from 1-16 to 1-8 of an inch thick. It had a peculiarly sickening, putrid smell, and its separation must leave the milk purer and sweeter than the methods in ordinary use. Thus it appears that the rapid centrifugal motion more effectually cleanses the milk than any straining can do.

The Centrifugal machine has other uses in Mr. Burnett's dairy, as the following will show:

"During the past few months I have had constructed a perforated basket for extracting the buttermilk by centrifugal force, and now treat all my butter by this method most successfully. After two or three rinsings in brine, it is removed from the churn while in small pellets and placed in a cloth. It is then put in the basket of the machine, which, in less than a minute after full speed is obtained, is brought to a standstill. The texture of the butter is fine and the grain uninjured and very solid.

Carrying my experiments still further I am able to show you to-night round pats of butter with my own private stamp on them, molded in this same machine, and I think more perfectly than could be done by hand."

Professor Caldwell speaking of the Centrifugal method says:

"Numerous experiments have shown that a greater weight of butter is obtained from a given quantity of milk with the Centrifugal creaming process than with other methods of separating the cream; in the various tests that have been made, this increase ranged from 8 to 30 per cent, the difference varying according to the character of the milk. It has been shown that this larger yield is really due to a more complete separation of the butter-fat from the milk, and not to a larger proportion of salts and water or other foreign matters in the butter; the skimmed milk from the Centrifuge is poorer in fat than that from the Swartz process, or from any other method of setting the milk for cream in common use in Europe. In several comparative tests, recently made, the proportion of fat in the Centrifuge skimmed milk ranged from 0.21 to 0.44 per cent; when the cream was separated by ordinary methods from milk of the same richness in fat, the proportion of fat left in the skimmed milk, though in some cases lower than the highest limit with the Centrifugal machine, was in others fully twice as great."

For making this method available a steam engine or other suitable power will be required.

I have spared no effort to secure a cut of this machine, but could not find one.

Another method of which we have heard, but of the operation and

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results of which I can get no information, is the "Vacuum Pan,' into which the milk is strained and then a tightly-fitting cover is placed upon the pan and the air pumped out, leaving a vacuum between the milk and the cover above. As before said, I have no reliable information to give of its workings nor do I know where such information can now be obtained.

Having constantly in view the object of giving a full and correct description of each system in use, the theory on which it was constructed and the merits claimed for it, without personal bias or prejudice, it is hoped this paper may meet the approval and be of some slight service to my brother dairymen of Vermont.

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WHAT SHALL BE TAUGHT IN THE COMMON SCHOOLS?

By EDWARD CONANT, Superintendent of Education.

It is the glory of America that she offers to every citizen the opportunity to make the most of himself. She says to no man: Remain in the state and follow the occupation of your father; nor does she say: Be rich, Be great, Have power. She says: Choose the sphere which seems to you fittest; limit your activity by the rights of your fellows; succeed according to the abilities given to you and acquired by you. She holds it for certain that rights inhere in men individually and that her part is to empower men to choose wisely and walk unhindered in the way chosen. Recognizing the fact that the chief obstacles to any man's success are in himself she attempts to put him in a way to overcome those obstacles by an early training in the right use of his powers. Ignorance, want of industry, want of integrity, disobedience to law are among the most frequent and most potent opposers of individual prosperity as they are the leaders of the forces that seek to undermine the foundations of the state. So the state seeks to displace these by intelligence, industry, integrity, obedience. The first of these is largely a possession, the other three are habits. To help men secure this possession—by means that will develop and settle in them these habits—is what the state offers by its schools.

As the guardian of every man's rights during the period which precedes his fitness to choose what he will attempt to be and to do the state should strive to furnish him with knowledge of universal value by methods tending to produce the universally required virtues. Hence the children should be collected in the largest practicable groups and be guided by the ablest and purest obtainable instructors. It is not good for man to be alone, is as true of his sons and daughters as it was of the first of men, and as God set them in companies in his ordering of human history he teaches us both by reason and experience that mind is kindled by contact with mind and in the case of school children it is best kindled by free contact with many minds acting under the inspiring guidance of a trained, active, forceful, superior mind. Why did not the Creator arrange it that man

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should spring up here and there from wind-scattered seeds and grow alone as some plants occasionally do? Why should men contradict the methods of their Creator in their attempts to educate children by separating them into the smallest possible groups necessitating the poorest possible conditions for education? One of the chief weaknesses of Vermont schools is the too great number of them. A chief difficulty with our teachers is that we have too many of them, too many at a given time and too frequent changes of them.

But the purpose of this writing is to inquire, What subjects should be taught in the common schools?

All men need certain instruments of learning and the elements of a knoweledge of nature and of man. As instruments of learning we may enumerate reading, writing and the elements of number and of form, as without the last two of these no definite conceptions are possible and by the first two we are helped to the use of what others have learned. Reading, writing and arithmetic are taught so universally and are appreciated so highly that the need of a still better teaching of them requires only to be mentioned here. A knowledge of forms taught by means of drawing in connection with suitable object lessons is of universal value. All material things have form and by reason of it serve well or ill our need or pleasure. The whole work of the mechanic is to shape and join things, and all farm work and house work is with and among things shaped, and is more or less successful as the things are rightly or wrongly shaped. That men and women may select more fitting tools and more beautiful garments, may arrange fields, gardens and rooms more conveniently and tastefully, drawing should be taught in all schools. That skill in drawing opens the way to pleasant and profitable occupations and prepares for a readier comprehension of several higher branches of learning is an additional reason for the same conclusion.

Out of the dust of the ground man was made in the beginning, and by the sweat of his brow must he still win his bread from mother earth. But his task will be lighter and his gains will be larger and su rer if he knows well the composition and capability of the soil he tills. We cultivate the soil that we may grow plants, a knowledge of the nature and uses of which will enable us to produce more and better than we can do without such knowledge. Plants are usefel to us in part directly and in part indirectly as food for animals. With domestic animals we cannot well dispense. Do we covet the condition of the aboriginal American without horse or ox, sheep or swine? But is not a skillful management of animals, based on a knowledge of their

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structure and habits, profitable to all? What most evidently differences man from the lower animals is his use of tools. Tools are material, their construction and use involve applications of force. Some knowledge of the laws of matter and of force should be imparted to all.

Branches the elements of which should be taught to all are mineralogy, botany, zoology, chemistry, natural philosophy.

Men dwell not alone. They are not like grains of sand. They act and react. Each has rights. Each is under obligations to each and to all. None can wisely discharge his obligations to society and to men unless he knows how society came to be as it is and what are the declared relations of men to each other and to the state.

The history and the constitution of our country and our state are among the things that should be taught to our children.

Man is older than any state or form of government. There are relations and consequent duties and rights of which the state takes little cognizance. These are universal and some of them are essential to the welfare of the state. The manners and morals of a people are more important than their laws and occupations.

Good behavior, which includes manners and morals, should be taught and practiced in our schools.

Here have been named a part of the subjects of which all men need practical knowledge. These are what farmers ought as farmers to be instructed in, and what all men ought to know.

The average Vermont school house shows for apparatus a blackboard. It should show besides that a clock, a dictionary, maps, charts, pictures, specimens of common minerals and plants, with means for making simple experiments in chemistry and physics, and a library. The average Vermont school house has a teacher who can give moderately good instruction in a part of the so-called common school branches. It should have a teacher who, besides teaching with utmost thoroughness those common branches, can systematically teach the additional branches already indicated. In the average Vermont school house a teacher is employed for twelve consecutive weeks, and is then displaced by a stranger. In that school house the teacher ought to remain term after term and year after year.

Is this wandering from the subject, what shall be taught in the common schools? Not if we really mean to have things taught usefully. If, as some affirm, reading, and penmanship, and grammar are so taught that not more than one in ten can read well, or write well, or speak well, or cipher well, can we expect that with only the same teachers, the same time and the same appliances, the introduc-

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tion of new branches would result in more than that occasionally one would be able to distinguish rock from rock and flower from flower?

The question, what shall be taught in our common schools? involves questions of means, and as the means to support schools depends greatly on the method of organizing society for the support of schools, it becomes a question of organization and of school systems.

The discussion of this subject so far has done good; a further discussion of it will do more good; and as the discussion progresses in will more clearly appear that the ends sought by the farmer and mechanic, who demand a technical training, and by the scholar, who demands a general training, are not inconsistent, and that neither can realize his hopes without some revision of our school organizations and methods.

How to proceed? Take greater care to secure the best accessible teachers. Do not allow a good teacher once employed to be quickly displaced. Add to the means for study and illustration such apparatus as can be had. Add to the length of the schools. Keep the end desired, a better education for all, and education by means of some new branches, constantly before the people, the teachers, the pupils. Enlarge and improve the normal schools, that more teachers may be prepared for the work we wish done. ABOLISH THE SCHOOL DISTRICT—*relict of a past age, that now* HANGS LIKE A BODY OF DEATH ON OUR SCHOOL SYSTEM.

Doing these things and making use of the most approved methods, we can introduce the new subjects named, and can teach better the subjects already taught.

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DISEASES OF DOMESTIC ANIMALS.

BY THE SUPERINTENDENT.

No little interest is being awakened at the present time throughout the country upon the danger which threatens us touching the diseases of our domestic animals; particularly so respecting pleuro-pneumonia, which has already insiduously worked its way into several states of the Union bordering on the Atlantic seaboard and is sure to find its way west in due time if unrestricted traffic in live cattle is permitted between the several states.

Under the auspices of the Illinois state board of agriculture a large meeting has recently been held at Chicago, attended by feeders and breeders and others interested in regard to the urgent need that congress should, at the earliest possible moment, enact laws to relieve the country upon this question. England has seen fit to place such restrictions upon the American cattle trade in consequence of the alleged prevalence of pleuro-pneumonia and other contagious diseases in some of the eastern states as to very much put in jeopardy the American cattle carrying trade, and hence has very justly aroused to intense earnestness those engaged in that business, as well as all breeders and feeders of that class of stock from which John Bull has been wont of late to pronounce more acceptable to his table and palate than much grown upon British soil. The meeting at Chicago was very largely attended; quite a number of prominent gentlemen being present, including several members of congress. It appeared that congress had attempted needful legislation upon the subject at the noted extra session, a bill having been drawn and submitted to the committee upon agriculture, which for reasons not fully known did not report it. The difficulty in the way was said to be this—a majority of the committee was so imbued with the doctrine of state rights that they opposed any measure

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that promised to bring relief. This reminds us of the man who was so much upon the order of his etiquette that he couldn't help another out of the water because he hadn't been introduced to him. We are to-day menaced with a contagion that if allowed to get a foothold in the western states, the loss to the American people would simply be incalculable; and congress thus far not alive to the issue. Let us hope that at the coming session needful legislation will be forthcoming. As our country grows older and our population increases, with the increase of our flocks and herds, and with unrestricted inter-state commerce, we shall be the more in danger of contagious diseases among our domestic animals, as also subject to the ravages of insects upon our crops. It therefore behooves state and Nation to leave nothing undone to meet these evils, when they appear, with heroic treatment.

A disease has shown itself the present season among our cattle in this state, which, according to our best authorities, is by no means a welcome one, and which is not certain to be easily managed. Some time in October Mr. W. H. Gilmore of Fairlee called my attention to some cattle owned by Mr. G. S. Melendy, of his town, that were ailing with something, they knew not what, and wished I would examine into it. I employed Mr. O. M. Tinkham to visit the herd and learn what he could about the disease and report; which he did and brought with him a portion of lung from one of the diseased and slaughtered animals, submitting a piece of the same to Prof. G. H. Perkins of Burlington and also a piece for examination to the members of the Vermont state medical association, then in session at Montpelier. Prof. Perkins pronounced the disease to be *Strongyli micrurus*. The medical association appointed Dr. H. A. Cutting of Lunenburgh to diagnose the case and report upon it, which the doctor did with his usual promptness and correctness, and we submit the same herewith, believing it to be of value to us all:

Having been instructed by the Vermont medical society at their late meeting here to investigate and report on the outbreak of pleuro-pneumonia at Fairlee, Vt., I would first state the case as presented before the society. August 1, 1880, Gardner S. Melendy of Fairlee purchased in Cambridge, Underhill, Fairfield and Fletcher 43

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calves and 33 yearling. Driving them home, (he arrived August 14th) they were turned into a mowing lot near his house, a dry upland, with good feed. After a few days he drove 20 to a pasture a mile away, and 10 into a pasture two miles away, and a week later he put 25 calves into a mowing field on the same farm. On September 8th he found a yearling sick in the pasture and drove him home. His eyes were sore and running, as did also his nose and mouth, respiration rapid, with frequent coughing, discharging when he coughed much offensive matter. This yearling lived until the 12th, when he died. A week later a calf in the home field was likewise taken sick, having the same symptoms for four days, and died; a week later he was told that a yearling was dead in the pasture, which he found true, and that several more were coughing, and a few days later others had died. October 8th 6 had died, and 18 more had the disease. At this time he was alarmed, and it seems from good cause, and Mr. Tinkham made a post mortem examination, and found the lungs badly congested and the air passages filled with small white thread-worms from 1 to 2 inches in length, and that their number was countless. This proved to be the Strongylus micrurus, and is the entire cause of the disease. It is described by Cobbold, and is alluded to by Siebold in his work on Entozoa. In 1833 there was a curious epidemic from this cause in England, destroying many cattle, especially calves and yearlings. A description of the same may be found in the Veterinarian, volume 6. In Guy's hospital report for 1836 the disease is described as causing symptoms exactly identical with what occurred at Fairlee, and thousands of cattle died. In 1840 they were found by Wyman infesting cattle in Connecticut, and were confounded with Strongylus filaria, a similar worm infesting the lungs of sheep. His description may be found in the American Journal of Science, volume 39. In 1843 J. B. Simonds described an epidemic among young cattle caused by worms in bronchi, which were also found in the bladder and intestines, with symptoms exactly as found in our case. His paper was published in "Transactions of the Veterinary Medical Association," published for that year.

In 1845 calves and young cattle died from this disease in France, under the same symptoms. It was epidemic and incurable, and thousands perished.

In 1848 it was equally epidemic in England, and is described in volume 21 of the Veterinarian. But great benefit was derived from nasal inhalation of ether, chloroform, oil of turpentine and rectified oil of amber.

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In 1649 it was described by J. G. Sandie, who says the same parasite infests sheep.

It was again epidemic in 1851, and benefit was derived from inhalation of sulphuric acid vapor, and from taking oil of turpentine in one ounce doses.

In 1868 this disease was first observed in New York. It broke out in a herd belonging to Mr. Wood of Woodville. His herd was isolated, and the infected kept away from others. The disease was controlled in that place only to break out with great violence in Alleghany county, New York, in 1870. The cases were examined by Thomas L. Harrison, secretary of the state agricultural society, and an interesting account of them was published in the journal of that society in 1871.

In the same year there was another outbreak of this parasitic disease in Seneca county. Several cases were fatal, but as the authorities had full control and all cattle belonging to infected herds were isolated, it did not spread to any extent. It was, however, noticed that all the poultry upon the farm died from "gapes," showing that this species of worm, if not identical with the species causing "gapes" in chickens, is at least capable of doing the mischief.

But without referring further to special cases, I would say that it is the great cattle plague of Holland and Germany, as well as England and France, and some authorities say that in the low meadows of Hammersmith, England, where cattle do not thrive, even donkeys which feed there have numerous specimens in their lungs when killed, and the pheasants in that vicinity nearly all die with the "gapes." It would be supposed that so fearful and often incurable a disease would have a history of its rise and progress; but such is hardly true of this parasite, and even its habits are not well understood. In England it is said to have originated in Cuba, while here it is spoken of as a disease of European origin. Some say one thing of the parasite, and others talk or write exactly opposite. Some say it is more likely to be epidemic in a wet season, others in a dry one, and while I show full deference to authority, I shall ascribe the Strongylus micrurus as it appears evident to me to exist in this section. I first became acquainted with them by finding them about sedge roots on wet ground as microscopic worms. I am not sure upon what they feed, but have noticed a fine brown sediment in their intestines which I believe to be vegetable matter, though they thrive best, producing most and growing the largest, when in the bronchial tubes of the calf. I have no doubt but that they attack the ox, horse, mules and poultry, as well as most wild animals, but the great

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fatality is among cattle. The numerous cases of "heaves" in horses, unaccounted for by over-draft or other disease, may largely owe to this worm their commencement. When full grown they are a thread-like worm, with the female two inches or a little more in length, and the male about half the size. The head is slightly rounded, with no neck. The mouth is furnished with three hooks, or, as called by some, papillæ. They are called viviparous, yet do not half the time produce their young alive, as in the specimen presented to me. Some of the lung cavities were full of eggs, in which the outline of the worm could be traced under high magnifying power, and though put in glycerine were alive and in healthy condition when put in water several days after their immersion in glycerine. After two hours immersion in water they hatched, and the little worms were barely visible to the naked eye in a strong light.

When the females are expelled from the lung in coughing, they are filled with eggs, which, though afterwards dried, or immersed in water, retain their vitality, as has been shown, for three years, ready to infect the creature that gets them inside. So it is unsafe to pasture infected ground for four years, at least. When thrown into water they live, after hatching, for a long time, seem to congregate about sedge roots, and, though they do not seem to become entirely matured, will attain considerable size, and cattle are infected by drinking them. When the eggs are dry they are like invisible dust, and in dry weather are doubtless wafted by the wind to considerable distances, and cattle are infected by breathing in the eggs. Thus it can be seen why the infection is considered to be from over-wet as well as from very dry seasons. It is not at all necessary that the female should lay her eggs, for if she dies she becomes literally a bag containing hundreds of thousands of them, all ready to spring into existence under favorable circumstances. But how are we to escape this subtle enemy? for such it indeed is. In Europe shires larger than our counties have lost their herds. It is often called pleuro-pneumonia, and treated as such. It is as fatal, as contagious, and as dangerous as any disease can be. Let our state awaken before it is too late. No one knows where the infection of this herd in Vermont was taken. They were driven across the state. They doubtless may have taken in their deathly disease with the dust they drew into their lungs on the road. They may have drank it, no one knows where, and no one can know how near it is to their own door. With the greatest interest of our state at stake, our legislature should not be amiss in providing against any possible harm to that interest in the future. Though no human hand can prevent death at some

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time, many diseases are subservient to the will of the people; and as the mosquito in India has been found to harbor a parasite that feeds upon its blood, and its eggs are deposited with those of the mosquito in water, which, if drank by man, produces that fearful disease of the blood-vessels, contorting the limbs, and rendering the infected incurable; while the mosquito goes on sucking up with the blood that he takes from infected persons, the parasite, to again infect others, as noticed, and thus originates the disease which incapacitates many of her people. As we ridicule them for drinking unfiltered water, might they not return the compliment? Let us learn wisdom.

The appearance of this disease in our state, together with the advent of the same or something like it at Haverhill, N. H., last winter, and the probable likelihood that they were but the beginnings of something more fatal to be dreaded in the near future, were sufficient reasons for immediate efforts towards needful legislation on the part of the present legislature. A bill was at once introduced by Senator Paul, from Windsor county, providing for the appointment of a commission by the governor, with power to isolate herds infected with a contagious disease, cause the destruction of any pronounced incurable, and make such other regulations as might become necessary in such an emergency, to the end that as little loss as possible should come to the people of the state. This bill, we understand, has already become a law, and will, so far as Vermont is concerned, we hope, answer the desired end, but national legislation is needed, and that at once, ere we repeat the mistakes of other states and countries, in loss of millions of dollars to our country.

That the magnitude of this frightful disease, the bovine lung plague, and the cost and trouble already made in some localities by it may be the better appreciated, we subjoin the following extract from an article from the pen of Prof. James Law, as found in the special report of the agricultural department at Washington upon contagious diseases of animals, No. 22, for 1880. This gentleman has been urging for several years "national interference to extirpate foreign animal plagues:"

"In approaching the subject of the protection of animals from native and

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imported plagues, we are overwhelmed by the vastness of the field, and are fully convinced that the public mind of the country is not fully prepared for the herculean task of suppressing the whole list. For the present, at least, it would be well that this work should be divided, and that a great portion of it should be left in abeyance until, by a successful experience with the more urgent of these affections, a public confidence in veterinary sanitary measures can be created. A large number of animal contagions, and of dangerous animal parasites, are communicable to the human subject, and these accordingly directly interest the National Board of Health, and demand its intervention on behalf of humanity. * * * *

Besides these there are a large number of contagions and parasites that confine their ravages to the *lower* animals; and that must he dealt with from a different stand-point, as impairing our agricultural industry and draining away the national wealth. Some of these already subject us to enormous yearly losses, the so-called hog cholera causing deaths of swine to the value of $20,000,000 to $40,000,000 per annum; the trichina having driven our hams and bacon out of the market in certain countries in Europe; the lung worms, intestinal worms, scab, and foot-rot having depopulated the sheep runs on large tracts which are admirably adapted to wool-growing; and the Texas fever having caused extensive yearly losses in the middle and northern states. But among all these, and many more, one affection stands out as pre-eminently demanding suppressive measures. The lung plague, which has for many centuries desolated the herds of Europe, has invaded our territory, where it has not only maintained itself for thirty-seven years, but has spread 300 miles from its original center, in a direction opposed to the steady current of cattle traffic. If neglected, it must take but a short time longer to reach the open cattle ranges of the south and west, whence it will be impossible to expel it. It is characteristic of every true plague that the wider its area the greater its power for rapid diffusion. The larger the tract of country infected the greater is the number of diseased herds and animals, and the greater the danger of shipments from such infected to states and districts as yet free from infection. Again the wider the infected area, the more extensive is its border, and the greater the number of points at which infection may be conveyed to adjacent herds in territory hitherto uninfected; also, the greater the area, and the more extended the outer line of infections, the greater the likelihood that this shall include a route or channel by which cattle are continually sent out into states as yet uninfected. Once more, the present increasing interest in live stock is determining a constantly increasing draft on the eastern herds for valuable sires to improve the cattle of the west and south. The wider the area of infection, the greater the likelihood that one such sire may be carried out to the plains and infect the fenceless ranges, from which the poison could never be eliminated. No more is wanted. *One animal* landed in Brooklyn has infected seven separate states, and *one infected animal* landed on the plains, or in Texas, will secure the spread of this pestilence over the whole country, and entail its permanent ravages among our herds. The momentous consequences of such an accident cannot be fairly estimated. Eng-

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land with her 40,000,000 of cattle, lost $500,000,000 in the course of thirty-five years; we with our 100,000,000 should lose over $1,000,000,000 in deaths alone in the same length of time.

This infection of the south or west may happen any day or any hour. The high class herds of our infected states are not exempt from this disease, and it has been our sad experience to see it in the finest Jerseys and Ayrshires. We have known the owners of such animals (thought to be convalescent, but really carrying large encysted masses of diseased and infecting lung within their chests) anxious to dispose of them and realize some salvage from the wreck of their splendid herds. No ordinary purchaser would have suspected these animals, and yet they carried within them that which, if transplanted to the west, might have proved the starting point for a general infection of the continent.

RELATIVE DANGERS FROM BOVINE LUNG PLAGUE AND OTHERS.

Like all true plagues, this gains new force with every step made in its advance. As the malady is developed in this country by contagion only, it secures an additional advantage with every new animal infected. Every new case of sickness is but another manufactory of the virus, spreading this on the air in countless myriads with every breath expired. No change of latitude or altitude, no modification of season or climate, no alternations of heat or cold, no change, geological or atmospheric, no alterations electric or telluric, will rob the poison of its virulence or destroy its vitality. The plague once introduced prevails alike on the mountain top and in the valley; on the sea-coast and on the inland plains; in the sweltering heats of Africa and in the frigid winters of St. Petersburgh and New York. The one condition of its propagation is the contact of the poison with the body of a susceptible subject.

COMPARISON OF BOVINE LUNG FEVER WITH YELLOW FEVER.

In connection with health laws and their administration, no subject has of late more profoundly exercised the minds of the medical profession and the laity than that of yellow fever. Yet, terrible as this malady is, and fresh as are our recollections of its devastations in Memphis and other southern cities, it is lacking in the most dangerous features which invest the bovine lung plague with its special pestilential character. Yellow fever cannot prevail in cold weather, and its germs are pemanently destroyed by the winter's frosts. No matter how extensive its prevalence in our summer, a severe winter will effectually eradicate it; and on the return of summer it must start anew from another importation, or perhaps from one or two centers where it may be developed in the United States itself. An unusual extension of the poison in one year gives it little or no advantage for the next, and therefore the loss of one or of ten years in applying restrictive measures will not in the least interfere with their final success. But with the lung plague of cattle, as we have seen, it is far otherwise; it advances with insidious but constant steps in summer and winter alike, and every new step achieved is a material and perma-

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nent gain in its progress towards a general infection. With this affection the loss of a year is a certain and permanent loss, and will entail a materially increasd outlay for its extinction, while in individual cases the loss of a single day, or an hour, even, may allow the irreparable infection of the plains.

Again, yellow fever is generally connected with filth, and will inevitably die out in the presence of absolute cleanliness. But the virus of lung plague is certainly reproduced in the body of the sick animal, and exhaled with every breath, so that it is diffused widely, and in a highly virulent condition on the purest atmosphere. No cleanliness of buildings or drains, no purity of the air, can protect against a contagion like this; the one effectual resort is to stop the production of the virus in the infected system, and to destroy what has been already produced.

COMPARISON OF LUNG PLAGUE AND TEXAS FEVER.

Texas fever is no more dangerous to cattle than yellow fever is to man. It extends from the states on the Gulf in summer only, and in all the middle and northern states a severe winter destroys its germs. Moreover, its virus is not diffused on the atmosphere, but is confined to the pastures on which the southern cattle have grazed. After these southern cattle have been removed, a simple fence is sufficient to bar its progress to stock in the field adjacent. The loss of a year in dealing with such a disease is therefore of comparatively little importance. The loss is of time only, for next year the fever has to begin anew its progress northward from its permanent home on the borders of the Gulf of Mexico. A neglect for any number of years does not very materially widen the area of its prevalence, and at any time in the future it may be taken up and dealt with as economically and with as good hope of success as it could have been at any period in the past. Yellow fever, therefore, and Texas fever, are to be viewed rather with respect to their present fatality than their future results. In this they are to be viewed as allied in their prejudicial results rather to injurious conditions affecting finance, banking, commerce, railroads, canals, shipping, etc.; the evil is not cumulative, and may be corrected at any time with immediately good results. With lung plague, on the other hand, the peril for the future increases in ratio with the animals and area infected, and the pestilence may at any moment pass beyond our control. If we leave out of view the moral aspect which gives yellow fever its special claim, and consider the three diseases simply as pestilences, there can be no hesitation in pronouncing the bovine lung plague immeasurably more virulent, more pregnant with lasting and irreparable danger, and more imperative in its demand for immediate administrative action than either of the others.

COMPARISON OF LUNG PLAGUE WITH SWINE PLAGUE, GLANDERS, CANINE MADNESS, MALIGNANT ANTHRAX, TUBERCULOSIS, AND MILK SICKNESS.

A comparison of these willl furnish abundant reasons why the preference in administrative action should be given to the bovine lung plague. The exotic origin of this plague of cattle, and its recurrence on this continent by

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contagion only, gives a most perfect assurance that we can permanently extirpate it. But with the other affections named it is far otherwise. There is a strong probability that all of these may be produced in our own land by unhygienic conditions—may be generated *de novo*—a first case may be generated without any antecedent imported one; and thus, although we could tomorrow extinguish every spark of the infections of these diseases, there are reasonable grounds for supposing that before the end of 1880 one or more new cases would have developed of themselves, and would require new efforts at extinction. No measures for the suppression of these diseases can therefore assure a permanent eradication of them, but a perennial vigilance must be maintained to suppress the centers of infection in the already diseased animals, and to remove one by one the mass of unhygienic conditions which are the creative causes of these affections. This is a work which will task the knowledge, wisdom and energies of many generations yet to come, and cannot be disposed of, like bovine cattle plague, by the energetic work of a year or two.

COMPARISON OE LUNG PLAGUE WITH SOME DANGEROUS PARASITIC DISEASES.

Parasitic diseases of animals have an importance that cannot be ignored. It has been shown that 8 per cent of the hogs killed in Chicago are trichinous; that lung worms have killed lambs by the 100,000 in single counties in Iowa, Ohio, Illinois and elsewhere; that much of the so-called hog cholera in different states is but the ravages of lung worms; that even scab temporarily ruined the wool-growing industry not long ago in Iowa, and still ravages certain other states; and that intestinal worms have been equally destructive in other directions. These mostly spread throught the eggs and embryos deposited in moist soil, and in wells, pools and streams, and may be carried by infected animals from place to place, but they are not wafted far on the air, nor is their preservation and extension so redoubtable as in the case of the lung-plague virus. Moreover, several of the parasites of farm animals infest so many others, wild and tame, that the question as to whether they can be certainly eradicated cannot be answered with the confidence with which we can speak of the extinction of the lung plague.

From these considerations of the most dangerous infections and parasitency of animals may be deduced the conclusion that the bovine lung plague is that which at present threatens the country with the greatest peril, and which at the same time can be most certainly and effectually expelled from our shores. For the others we can afford to wait; but with this delay is suicidal.

NEED OF EXECUTIVE ACTION BY THE UNITED STATES GOVERNMENT.

The necessity for action being admitted, the question arises, By whom should such action be taken? New York is operating under state authority, and many think this all-sufficient, and point to Massachusetts as an example of the successful extinction of the malady by an individual state. But the same course could never have been successful in Massachusetts had she, like New York, been the *entrepot* for cattle shipped from infected states. Massa-

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chusetts has kept clear of this plague for fifteen years, it is true, but this could never have happened had her weekly accessions of thousands of cattle been drawn from Long Island, New Jersey, Delaware, Virginia and Pennsylvania, in place of from the great uninfected west. In view of the vital importance of national action in this matter, we submit the following

REASONS WHY THE WORK OF STAMPING OUT THE LUNG PLAGUE OF CATTLE SHOULD BE A NATIONAL MOVEMENT.

1st. The plague is an exotic, and if once suppressed would never reappear in Amcrica, unless reimported. It is the duty of the national government to protect the entire Nation against a foreign invasion, and against any importation that tends to ruin our native industries. Therefore the national government should extirpate this imported pestilential incubus on our live-stock industry.

2d. The plague is gradually extending to the west and south, and if neglected must lay the whole continent under contribution. It is the duty of the United States government to regulate and protect inter-state commerce; and if it allows one state to harbor and dispense a disease which is not only ruinous to her own cattle trade, but also to that of her neighbor, it is forgetful or untrue to the sacred trust reposed in it as a national administration.

3d. If the plague were to reach the unfenced cattle ranges of the south and west it would be impossible to eradicate it, as herd mingling with herd would infect each other, and one herd succeeding another on the same pasture would take in the infection left by its predecessor. Wherever this disease has been introduced into such open common pastures the same result has followed—it has maintained a permanent residence. For example, we need only point to the steppes of Europe and Asia, to Australia, to South Africa, and to the common pastures around our large eastern cities.

4th. The state wealth in the south (Texas) and west is made up of live stock to a far greater extent than in the east; and the foreign market for beef is supplied mainly by the west. It follows that the west has a far greater interest in this matter than the east, whether viewed in the light of the preservation of their own herds or the maintenance of their foreign market. The west, therefore, or, rather, the whole country, should contribute to the expense of exterminating this disease.

5th. The disease is more violent and fatal in warm climates than in cold; therefore the relative mortality must be greatly enhanced should the affection be subjected. as it soon must be, to the hot summers of the Gulf states and the Mississippi valley. This, again, is a cogent reason why the as yet uninfected states should join in stamping out the pest before it shall have invaded their own herds.

6th. The infection of the south and west will inevitably spread the disease over the whole of the middle and eastern states. Texas and the plains are at the source of the cattle traffic. Their live stock are sent north and east to

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finish off, and are shipped to the seaboard in railway cars. If once infected, the western states must, therefore, rapidly spread the infection into adjacent states and contaminate the railroad cars, loading-banks and yards, so that these, in their turn, must become active media of the poison. No state, therefore, can be protected if once the west becomes infected. The following may be adduced in further illustration of this:

7th. As the seeds of this disease remain latent in the system for a period varying from ten days to three and a half months, and only become manifest by their effects at the end of this time, infected cattle may be carried from ocean to ocean, or from the Lakes to the Gulf, and remain thereafter for weeks and months in apparent health, and yet spread pestilence and destruction in the end. With such a disease, and with the large cattle traffic from the west, it is certain that contagion must be quickly carried in the channels of such traffic as soon as the infection shall have polluted its source.

8th. If, to avoid this danger, it is proposed to quarantine all cattle passing from state to state, safety would require a quarantine of at least three months (this was the period of incubation in the cattle that infected Norway and Australia, respectively, and the period was still greater in the case of the bull that contaminated South Africa). Suppose a quarantine of this kind were to be attempted at Buffalo. The regular daily shipment is five trains of thirty cars each, representing 3,000 head of cattle. Detain these for ninety days and you would accumulate 270,000 head of cattle; so that any such system must speedily break down by its own unwieldiness. It should be stated that the above estimate is still far beneath the real numbers, as the number of cattle trains passing east is frequently double or treble what has been quoted. Our supposition is based on the regular trains only.

9th. Chronic cases of lung plague, in which a large mass of lung has become encysted, may carry this mass for months, or even a year, before all can be liquefied and absorbed; and at any time during this long period such cases may become actively infecting by the escape of materials from this pent-up virulent mass. Against this no quarantine on a large scale can guard; and as even a most careful professional examination will not always suffice to reveal the presence of the smaller masses, infection by animals in this condition becomes inevitable wherever a large traffic is carried on.

10th. No state can be rendered secure unless all the states are cleared of the pest. In the past year New York has practically cleared six counties, and the disease is now mainly confined to the single county of Kings. But New York, as the great mart for cattle from the south and west, must be again speedily infected unless her neighboring states can be cleared at the same time. If an attempt is made to keep her clear, this state must maintain a most exasperating quarantine on New Jersey and the other infected states south, and must allow no bovine animal to move in the border or river counties, save under police control and by permit; and to make this sufficient, she must maintain a permanent staff of professional inspectors engaged in this business.

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11th. Smuggling into one state by residents of another, who can sell and return home with the proceeds before the officers of the invaded state can lay hands on them, is a not unfamiliar experience with us in New York, and must occur to all states adjoining an infected one so long as there is not one executive sanitary administration for both. The power to control equally in both states, and to promptly punish in the one for infractions of the law in the other, would effectually prevent such practices.

12th. With different authorities in adjacent states, it becomes difficult or impossible to trace infected stock smuggled from state to state; and if the second state, having been hitherto uninfected, has no sanitary administration, the smuggled animals may be distributed at will, and the area of infection indefinitely extended.

13th. With different authorities in different states, and with different systems and measures, mistakes and losses are frequent, and much trouble and loss accrue to both state and purchaser, which would be altogether obviated if the system and control were one. As between New York and New Jersey this has been a source of frequent trouble; and cattle have been thrown into the former which the authorities would on no account have admitted, and which the New Jersey authorities would not allow to return.

14th. One method of smuggling, which has caused a good deal of trouble in New York, is the shipment from the Jersey City stock-yards of a few milch cows among a boat load of fat steers, and the running off of such cows into the city and suburban dairies of Brooklyn. This could have been easily prevented had the same power controlled the two states, and had the Jersey City stock-yards been subjected to the same rules as the Union stock-yards in New York. In the latter, cows from safe districts only are allowed in the inspection yards, and all cows entering the yards for fat stock must be slaughtered. In Jersey City milch cows and fat steers occupy the yards indiscriminately.

15th. Uniform action by one authority in all the states would remove the source of much irritrtion among dealers, who have now to inform themselves as to the restrictions imposed in the different states, and are liable to make mistakes and get into trouble because of the different regulations in force.

16th. It has been decided by the supreme court of Illinois that any state law forbidding the introduction of cattle from a neighboring state, on the ground of suspected infection, is unconstitutional. It would, therefore, appear that no state has the power to exclude the infected cattle of her neighboring state, but must wait for their entry, and quarantine or kill them on her own soil. This would demand state officials and quarantine yards along the whole frontier, so as to keep up a watch day and night, at a ruinous expense. This is fully as preposterous as the proposal to examine and quarantine all animals in transit, and would be practically impossible. If in this matter the individual state cannot lawfully protect herself it devolves on the United States to give the necessary protection, on the principle of controlling and regulating inter-state commerce.

17th. Three of the states now infected have shown no tendency to act for

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the extinction of this plague; so that, unless the United States comes to the rescue, it will be impossible to eradicate the pest from the country, and the great outlay and effort of the states now engaged in the work of extermination will be money and labor lost. The retention on the continent of a single infected beast, or of one infected place, is sufficient to repeat over and over again the sad results of the landing of the one infected cow in Brooklyn, in 1843.

18th. The United States can alone protect us against a renewed importation. If the quarantine of our live-stock imports is left to the control of the different states, we shall have the most varied and unequal measures. A short quarantine in one state may be looked upon as a premium to her own importers; but this will sooner or later entail the infection of that state, and, through her, of her neighbors; though *they* may have maintained a really protective quarantine on foreign stock. As we anticipated, the attitude of the United States government toward Canada has led the latter to follow us in imposing a ninety days' quarantine on all European stock. But of what avail is this, if through any of our own states European cattle may be introduced, and with a sham quarantine, or none, may be sent inland wherever they list. A case of this kind has just occurred, and deserves to be exposed in all its shameful recklessness. In the first week in November, a cargo of forty cattle, the property of Messrs. George Brown & Co., of Aurora, Ill., were landed at the port of New York, and at once sent over nearly one thousand miles of rail into the Mississippi Valley, and to within 30 miles of the great centre of the western live-stock trade. The complaints of New York importers, who are themselves subjected to a three months' quarantine against such discrimination, are just; and in the face of this incident the demand becomes imperative that the treasury department shall revoke so much of its present order as permits the duration of the quarantine of European cattle to be determined by the rules of state or municipal authorities. While entirely ignorant of where the blame rests in this case, we cannot too strongly condemn the system that allows cattle to be brought from a country with the record of plague-stricken Holland to be landed at the port of New York; to be conveyed in railroad cars for nearly 1,000 miles; to be unloaded, fed and watered, at frequent intervals, in the yards used for our native stock on their way east, and to be finally placed among a stock of 100 head, which the owner is ready to sell at any moment, or to any point. It is probably true that Mr. Brown was very careful to see that his animals for importation were selected from districts supposed to be free from infection; but what assurance had he that the disease was not lurking among the herds, and even in the very animals purchased by him? Or, being assured on these points, if such assurance were possible, how could he guard himself against the many chances of infection while his animals were in transit? If such things are to be permitted, we may as well fold our hands and resign our herds to the merciless pestilence, for all our present toil and outlay must finally be lost; and, in spite of all temporary and dear-bought successes, a permanent riddance of the plague can never be secured. If the national government cannot take this matter in hand, and

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impose an unalterable quarantine of 90 days on all imports of cattle from Europe, then New York, New Jersey, and Pennsylvania may wisely abolish their cattle-disease commissions, and turn their attention to something more promising; for an infection of the west, which, under the present system must occur sooner or later, will more than undo all that they can accomplish, and permanently blight the agriculture of the nation. To-day the national government is on trial. It is not yet too late to avert the crushing load of taxation for the future generations of the American people; but it can much more easily, and by simple inaction perpetuate a system which must infect our western stock ranges, and reduce them to the condition of the pestilential Russian steppes, against the infected cattle of which Austria and Prussia can only protect themselves by patrolling their whole eastern frontiers day and night with *gendarmes* stationed every two hundred paces.

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REPORTS OF A FEW MEETINGS.

We publish a short account of a few of the many meetings held, as reported by Mr. Tinkham. As a rule they were well attended and full of interest and were productive of good.

MEETING AT CHESTER.

The farmers' meeting at Chester was called to order in the hall of the Central Hotel, at 10:30 A. M., on Tuesday, the 11th instant, and was organized by choosing J. J. Miner, Esq., chairman, and J. H. Adams, Merrill Stevens and O. M. Tinkham committee of arrangements.

The committee reported as topics for the consideration of the meeting, fertilization, drainage, dairying and care of stock and farm barns. The last topic was first taken up, and Mr. Tinkham was called up to speak on the subject.

AFTERNOON SESSION

was opened by the superintendent by a discussion on drainage. He began by relating his experience on his own land, where he had two acres of swamp land which was an offence to his sight, and on this they used to finish haying, getting about two loads of bog hay, which was worth nothing except for bedding. He concluded to drain it, though his neighbors said he had better let it lie, and buy two acres instead; but if he did that the unsightly spot would still remain.

He drained it by putting in a large main drain of stone, made by putting up side walls and covering with flat stones; and then put in lateral drains of tile. He plowed the land, giving it a slight dressing of manure, and now this land, instead of being an eye-sore, was the most productive he had on the farm.

He next described the methods of draining with tile, stones, planks, stone set sidewise; but he thought tile or stone would be best.

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Mr. Tarbell stated his practice of setting slabs up edgewise and nailing them together V-shaped, turn the edge up and then fill in about it with stones. It had worked well with him.

Mr. Stevens spoke of the methods of draining. He had used mostly stone drains, and they had worked well. He related an instance of draining a meadow about 14 rods wide by 60 rods long, and worthless, where cattle would get mired in the spring when he was a boy. After drainage it was plowed and planted to corn, and raised as handsome corn as he ever saw. He spoke of the necessity of placing the drains so as to cut off the springs; it might often be done with little trouble; much less than where a system of draining was had without reference to where springs were situated.

Mr. Chandler of the *Record and Farmer* spoke of the amount of waste land in Vermont, which might be made productive by drainage. This increased value was not always to be seen the first year. Time must be had for the decay of the vegetable matter and to change to its better condition, and in two or three years it will come to full bearing, and then it will be lasting. He thought small stones thrown in would make a good drain under some conditions.

Mr. Aldrich did not believe in using small stones in such a way; but they should be laid in nicely, carefully laying in the flat or large ones top.

Mr. Williams said he had drained a meadow of 30 acres, which was largely a swamp and entirely worthless. He had put in about a mile of drain, and as he had plenty of stones he had used them for drain, laying up side walls and covering with large stones; and now it was the most productive and valuable land on his farm. He had put down his drains at a depth of 3 1-2 feet, and he would endorse the remark of Mr. Tinkham, that in draining it was especially true, that "Whatever is worth doing at all is worth doing well;" and though the work was buried out of sight, it would pay to have it well and thoroughly done.

Mr. Tinkham said the best material for drains would depend on circumstances. If the drainer has on his land stones which he wants to dispose of, and has no better way, he may lay them into drains and make good ones, too; but if the stones were just over the line on his neighbor's land he could better afford to buy tile and put down, rather than draw and lay the stones, for it would cost less and make equally good drains for small ones—large ones would be cheaper made of stones.

Dairying was next taken up, and Col. Mead opened the subject by describing the condition of the dairy business, its depressed condi-

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tion, the small yield of the average cow, the low price received for the butter, and the need of better cows, better methods, more care in its making and handling. Cows should be selected for the purpose for which they are designed to be used; select, for butter cows, those which are valuable especially for butter; for cheese, those valuable for cheese. Feed for the result desired; exercise great care in the cleanliness of your cows, in the handling of the milk, in the making and marketing of your product, and increased profit would be the result.

Mr. Tinkham next spoke of the different methods of feeding, of setting milk, of making and handling butter, advocating scrupulous cleanliness, after which he was questioned as to salting, working and marketing butter, to which he answered: Salt to the taste of your customers; work as little as possible and have the salt thoroughly incorporated, and put up in shape to suit your customers; and when you have found a good customer, hold to him.

Mr. Bliss was called on, and gave account of his visits to the international dairy fair, the American dairymen's association, etc., and spoke of the creamery system of butter making, and there was an unlimited demand for good butter, and there was an over-production of poor butter only. Creamery butter was formerly made from the top of the milk which was churned, and this containing only the more oily portions of the cream, would not keep; and the practice had been abandoned. The keeping quality of butter is improved by leaving the cream longer on the milk, and butter made from cream raised by any system, and taken off at 8, 10 or 12 hours will lack in keeping quality. Butter globules differ greatly in size, and the largest rise the soonest, having less specific gravity, while the smaller globules, of greater gravity, rise more slowly, and are richer in margarine, and the cream left longer on the milk gives more firmness and better keeping quality to the butter. This matter of the rapid raising of cream was no new thing. He discovered it 28 years ago, and in the first report of the dairymen's association is an old paper of his, written years before. He advocated the careful working of butter, with caution not to work too much.

The butter sent to market by carload is culled, and the best is sold at prices which are not reported in the markets. The best butter sold in the markets was from farm dairies.

EVENING SESSION

opened by questioning Mr. Bliss on coloring butter, which he recommended, and condemned carrot as a coloring. After Mr. Bliss,

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Col. Mead took up the question of fertilizers, after which some discussion was had on the raising of corn in Vermont; several gentlemen expressing themselves in favor of Vermont growing all her corn, while Mr. Bliss and Mr. Putnam of Grafton thought it could profitably be done.

The meeting was closed by the superintendent, by remarks on the value and necessity of a higher education.

The meeting has been a success in point of numbers, over two hundred being present, and the interest unabated throughout the entire meeting.

A resolution of thanks to the superintendent for the meeting was passed, when the meeting adjourned.

VERMONT FARM MACHINE COMPANY'S MEETING.

The Vermont Farm Machine Company of Bellows Falls, the manufacturers of the Cooley milk setting apparatus, their excellent evaporator, and the Gleaner horse rake, took in hand the matter of an agricultural meeting in their vicinity, and their new building—just finished—offered an excellent place for it, so it was held there, on the 9th and 10th instants. Their new building is of brick, 60x100, three stories and basement, and in the upper story the meeting was held.

We were unable to be there until the second day, and cannot therefore give a report of the addresses delivered by Mr. Goodman of Lenox, Mass., Dr. Hoskins of Newport and Col. Mead, state superintendent of agriculture.

The morning session of Wednesday was opened by a talk by the agricultural editor of the *Freeman* on feeding. Chemical analysis creates nothing, invents nothing; it divides, separates and measures the different properties of different foods, and gives them names, names which always mean the same thing. If one breaks an egg, he finds in it two semi-fluid substances; the first nearly transparent, the other an opaque reddish yellow, which he calls the white and yolk. If the egg is set under a hen, we find in twenty-one days a miracle. The two fluid substances are gone and a perfected living animal organism now fills the place they occupied; an organism which takes various substances, grain, grass, insects, etc., and from these increases its substance. Bones grow larger and longer, they are covered by muscle or lean meat, and that mixed with or covered

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by fat. The material in the egg, and the substances the animal eats, must therefore have identical properties, as both serve the same purpose, namely, the creation of animal substance. Here the chemist comes in and with his science finds that the yolk of the egg contains all the mineral matters found in the animal, while the white is what clothes the bones with muscle, and this is called albumen, and from this, those foods which serve that end, the increase of muscle, are called "albuminoids," which are also changed into fats. The bones, consisting chiefly of lime, are supplied by "phosphates." If instead of putting the egg under the hen, it be left exposed to the air and its ordinary temperature, the change before noted does not take place, but change and decay soon follow; from which it appears that while all the *material* for the body is in the egg, some important element of life is absent, namely, that of heat, which is generated in the animal by combustion when it takes food. Chemists say this heat is due to the combustion of carbon in the system, and foods supplying the heat-forming material are called "carbo-hydrates." These three necessities of animal life are supplied in foods of different kinds, in different degrees, and different foods are necessary to their supply in the required quantities and at the cheapest rate.

The coarse fodders, meadow or bog hay, straw and corn stalks, have a positive food value, and he who throws them into the yard or stable for manure loses that value. While the amounts of albuminoids and fats are considerably less in these than in good upland hay, the carbo-hydrates are present in but a slightly less degree, and in corn meal, linseed meal and cotton seed meal the albuminoids and fats are much more abundant, some samples of cotton seed meal showing from 38 to 45 per cent. A feed which will furnish the required quantities of albuminoids, carbo-hydrates and fats can be supplied from straw, cornstalks and poor hay, with the addition of some of the more concentrated foods named, which will give better results at much less cost than can be done by using good hay alone; some experiments in feeding showing a saving of about one-third in cost.

Farmers cannot now afford to waste the food value of their straw, corn fodder, etc., to use them as manure, for the manurial value is lessened by only about one-fifth by passing through the animal. Corn cobs have a value as food, besides a mechanical value as a divisor of the heavier particles of meal, and he believed the farmer who threw them away lost in the act.

We have reached a point where we must use and save all that can

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be used and saved and a fair margin of profit may be found in the system of feeding which utilizes to the fullest the food values of what is raised on the farm.

Dr. Hoskins next spoke on "Fallacies in Dairying." He spoke of the Mr. Douglas efforts in favor of deep setting, and said he told Mr. Douglas that he thought deep setting would not make much headway till somebody got a patent on it. Some one must have an interest in a thing to make it go. One interested could see a poor article, while one not interested could not see a good one. He spoke of receiving books on agriculture from McMillan & Co. of London, in which the old theories which had long been exploded here were stated in the boldest manner. One was that milk could be kept at 37 degrees for weeks and no cream would rise. He had some theories on cream rising which he would not venture to express here, but he thought it not so much a matter of *height* of temperature, as of *uniformity* of temperature. He next noticed the report of an experiment which had been published where two Jersey cows had been added to a herd of grade Shorthorns, and the yield of butter but very little increased. He cast some doubt on the facts set forth, as he should have expected the addition of milk having larger butter globules would have helped the smaller ones to rise, and the same in churning, the larger globules to help the others to come to butter. He next spoke of a statement made by Dr. Sturtevant that Jersey milk was not fit for food by reason of being too rich, and that children could not be raised on it. He thought this a fallacy, as he had now in his family a young lady 18 months old, who was perfectly healthy and very strong, raised from her birth on the milk of a Jersey cow.

Another fallacy was the flavor from feeding turnips. This flavor was sometimes present when no turnips were fed, and cows fed half a bushel per day would show none of this flavor. Mr. Walker of Springfield raises 500 bushels of turnips every year and feeds them to his cows and sees only good effects; his butter sells well and no fault found. He fed a pair of oxen on rutabagas and when one was slaughtered the consumers complained of a bad taste in the beef, but one which was not killed for some days had no such flavor. Mr. Huskinson of Mt. Holly raises 800 bushels of turnips yearly and feeds to cows; finds them excellent for butter and for beef. Good feed was necessary for good milk, and Jerseys could not make good rich milk from poor feed, and some pastures would give feed which would make much better, richer milk than others, and the pastures of Springfield would not equal those of Mt. Holly. C. Horace

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Hubbard, Esq., agreed with gentlemen on the influence of food on milk, and that a judicious feeding of turnips would not impart any objectionable odor to milk. He had fed half a bushel per day to cows from which he was selling milk, and to those who would have detected and condemned such a flavor, and had no complaint. He had always fed his cobs and thought them worth it.

Mr. Goodman spoke highly in favor of cobs as valuable for food and rich in potash. Gen. Davis of Cavendish always fed cobs and believed them valuable, also spoke of the Jerseys for milk and for beef as well—believed he could make as many pounds of beef from the same feed from Jerseys as from any other breed.

Farmer Sanborn of Hanover, said he must tell a joke that a Franklin county man got off on Friend Tinkham. He told him that they used to keep Jerseys, but had had to give it up, and when Tinkham asked the reason, replied, that the cats got to catching the calves!! Mr. Sanborn thought turnips could not be raised and housed and sliced and fed with profit here. Cob meal had been found to be excellent to feed with corn meal to pigs.

Prof. Alvord of Easthampton said he had charge during the war for eight months of from eight hundred to twelve hundred horses and mules which were fed corn on the ear, and while fed all the grain and hay they wanted, not one in a hundred but would eat up the cobs, and not one cow in ten would leave them, and he believed the animal knew what it wanted and needed and consequently cobs were valuable. He believed turnips were valuable and would pay to raise, and corn fodder and straw too valuable not to be utilized for food for stock.

One thing he had noticed in Vermont and western Massachusetts butter, that while the spring and summer butter from Vermont was best, in winter that from western Massachusetts was best. Certain dairies keep up their excellence, but the majority do not. The reason he thought was that the winter feed was best in Massachusetts, where more roots and grain were fed. He believed there was something in the extract noted by Dr. Hoskins of the failure of increase in the butter yield where Jersey cows were added. He had once a herd of Norfolk polled cattle which made good butter, but it was very white. He added two Jersey cows, which much improved the color, but did not materially increase the amount of butter.

The time for adjournment having arrived, Mr. Williams, the treasurer of the company, invited those present to a "basket picnic" in the room below. On adjourning there, two large tables were found extending the length of the room, which were well supplied with

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oysters, cold turkey, chicken and tongue, bread, sandwiches, etc., tea, coffee, skimmed milk, pies and cakes of various kinds, apples, oranges, etc., which, if a basket picnic, is our favorite kind of meal and so far as we had time to observe, all who sat down to the well loaded tables were evidently of our way of thinking.

The afternoon session was opened by a brief discussion on fertilizers, after which Prof. Alvord read a paper on "Improvements in dairy implements." He said America was far in advance of all other nations in the number and excellence of her labor-saving machines, as a visit to agricultural hall in the centennial exposition would have made apparent. American machines are made for use, and fitted for their especial purpose, while the English seem to aim to get in all the material they are able to. Their plows are twice as long and three times as heavy as ours, and their carts have twice as much material in them as ours, while their loads drawn are no heavier, and the roads far less trying. On the continent the contrast is still greater.

He next spoke of the mechanical activity of the country. There were over two thousand patents granted on harvesting machines which was not to be wondered at, considering their importance and the number of parts, but an equal number had been granted on churns. He reviewed the mechanical aids to dairying.

Dairying begins at the pail, and here a great reform was needed. The pail in common use was as bad as a pail could be; generally largest at the top, it seemed fitted to catch all of any possible filth about the animal, and expose the milk to the foul air of the stable. It is a pretty severe thing to say, but he would say it—he did not believe that one out of ten of those even before him, did their milking properly. He showed some improved pails with covers and places to admit the milk.

Milking machines were next considered, their history traced, and they were classified as "suckers," "squeezers" and "strippers." The milking tubes, which are not included in those named, were classed by the patent office as surgical instruments and not fitted for general use. None of the milking machines were a success, but when we remember that an average of ten millions of cows have to be milked twice a day, and that the entire time of two hundred thousand men would be required to do it, there would seem to be a sufficient incentive to the inventive genius of America.

Most of the dairy implements at the dairy fair were from Vermont, and some of the best of shallow setting systems were of Vermont origin.

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Deep setting had been in use for more than a hundred years in the "spring houses" in the south. On his farm in Virginia it must have been in practice from seventy-five to eighty years. He had no patience with those who claimed to get more butter by deep or shallow setting. By taking the same milk and observing the proper conditions, all the butter can be obtained by either method. The duty was one of labor-saving for the wives of the home.

Of systems of deep setting, selecting ten of those which attracted most attention, and five of the best of these come from Vermont. Several of these have great merits, and should one ask, Which is best? he would reply, That one best fitted to the needs and conditions of the farm.

Of the Cooley creamer, he would say that in some places it was not needed, while in others it was indispensable.

In reply he said there was nothing in climate or food to hinder making just as good butter in Virginia or Mississippi as in New York or Vermont.

He next spoke of the "Centrifuge," and thought it would be practicable only for creameries or large dairies.

Deep and shallow setting required different churns, as the cream of one was much thinner than that from the other.

For a worker he preferred the simplest; either the lever or the lever and roller combined.

More care in processes is needed, and farmers need a more thorough, longer and more scientific education; they should keep posted in dairy apparatus, and study whether it is fitting for their needs. A first-class workman may succeed with poor tools, but generally he who has the best tools makes the best work.

Following Prof. Alvord, Mr. Sanborn of Hanover, gave a talk on how to make farming pay in New England. At the close of Mr. Sanborn's remarks the following resolution was offered by C. Horace Hubbard, Esq.:

Resolved, That the cordial congratulations of the audience be tendered to the Vermont farm machine company on the successful dedication of this fine building; for their enterprise in promoting the arts of the dairy, and for the profit and enjoyment we have derived from the series of meetings now about to close; also that our thanks be tendered to the gentlemen who have addressed the meetings with so much ability;

and passed, when the meeting adjourned, which we hope is the first of a series to be held yearly.

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AGRICULTURAL MEETING AT NORTHFIELD.

The meeting appointed by the superintendent of agriculture, at Northfield, was held in Concert Hall on Friday, the 26th instant. The superintendent was assisted by Prof. W. O. Atwater of Middletown, Conn., and Mr. O. M. Tinkham of the FREEMAN. The hall by some mistake was not well warmed for the morning session, but the farmers in caps and overcoats gathered about the register, and the session was taken up chiefly by Mr. Tinkham in a talk on dairy matters, and, by request, some account of the late international dairy fair was given.

AFTERNOON SESSION.

The meeting was opened by a duette by Miss Rumrill and Mr. F. B. Houston—Moonlight on the Rhine—a beautiful piece well rendered. The next was a paper by Mr. D. T. Averill on manures, and he opened by speaking of this time as an era of new departures, and he welcomed these new departures. He spoke of the richness of western soil and the necessity of Vermont farmers saving every possible particle of plant food. He spoke of the old and new style of farming, and cited an instance of a farmer of his acquaintance who, living within a stone's throw of a grist mill, where he could have secured any desired quantity of India wheat hulls, and but a short distance from a chair factory, where he could get shavings to be used for bedding and absorbent; but he had never used any, and his horse had never had a bushel of bedding where he might have had hundreds every year. He, some years since, had begun to use India wheat hulls for bedding, hauling them a mile for the purpose, and was the subject of much ridicule, but now all the hulls are saved and the miller is able to sell them for a fair amount. He spoke of the improved systems of farming, of sheltering and saving manure, the saving of the liquid as well as the solid portion, and that the roadsides were laid under tribute to furnish good absorbents. He next spoke of Vermont as a desirable spot for the farmer's home, and enumerared some of its drawbacks and its advantages, and thought Mr. Douglas was right when he said it was a good place to be born in—but wrong when he thought one should emigrate early. He spoke very severely of the railroads and their discrimination against Vermont, and in favor of western producers, and characterized their action as shameful, when they owe their existence to the power of the state.

Col. Mead followed Mr. Averill, saying he should speak of that part of the paper which treated of the desirability of Vermont as a

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home. He did not know but that was a hobby of his, his friends had charged him with it, and he was not disposed to deny it; if it was true, it should be published; if it was false, it should be ventilated. He gave the fact of Vermont's having for the last 15 years maintained very nearly its product per acre, while the west had fallen off very materially, and the time was not far distant when the yield would be equal and the west would be obliged to give equal attention to saving manures. He spoke of education of the youth; that they be educated to work and not have wealth thrust on them, not to have them expect they may step out into life at once on a life of ease and luxury. He deprecated the decreased and decreasing population, and thought we should not throw away our best bone and muscle, we should raise men and women, and it would be happy for Vermont if she could hold her own in the coming census and not show a decrease in population. He believed Vermont was in the path of progress, that we raised better crops than we did but a few years ago, that we raised more hay and more corn and wheat per acre than we used to, that we had increased the yield of our dairies and the number of cows to the acre, and we should increase our population.

Mr. Vail of Pomfret was called on to give some report of dairy matters in his vicinity, and said that his neighborhood was mainly given to dairying, and that there had been a marked increase in the yield of butter per cow and of cows to the acre, and the result had been a decided improvement in quality and increase in price. The former average he believed—the average 15 years ago—would fall short of 100 pounds per cow, and now there were half a dozen dairies which would average 250 pounds per cow, which was the result of better cows, better care and better feeding.

Mr. Vail was asked whether the men who had done this had capital to start with. He thought many of them were in debt when they had gained these results. Q.—What amount of hay and grain had they purchased? Ans.—Little of hay, but considerable of bran and western corn. He believed the results of high feeding had been a better quality of product and an increased profit. The best feeders had reached 300 pounds per cow. Here a man arose in the back part of the hall and said that this week there was a farm to be sold containing 150 acres on which a man had farmed it for years; on which his father built his log cabin, and which the present proprietor inherited, and from this sale his creditors hoped to realize 30 cents on the dollar. He knew another farm lately sold for $1,700 which had formerly sold for $4,000, and he wished to know the rea-

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son for it, and what was to be done to remedy this. Col. Mead said he could not give the reason, but he knew a dozen young men who would gladly take such a chance as that, and he knew many farms which had doubled their product within a few years, and he believed that in five years more the average dairies would reach the product of our best dairies now, and the best dairies proportionately increase. Mr. Tinkham said he wished to ask the gentleman a question. He knew the facts in the case; it was something which had taken place under his eye, and what he wanted was that the gentleman should answer his own question, and what *was* the reason the man had failed. He said he believed it was what the neighbors called "want of management;" he was not constituted like the other gentlemen named.

Prof. Atwater said what was wanted was more brains in farming—he meant the making of farming more of brain work. What would be thought of a merchant who did not know what his goods cost, or how much he had on hand, or how much he had sold? Yet that was just what many if not most farmers were doing.

EVENING SESSION

was called to order by the president at 6:45, and the choir gave a fine piece of music, after which Prof. Atwater gave his talk on feeding the stock and the soil.

After Prof. Atwater Prof. Dole read a paper on the future of Vermont in agriculture, which we shall give entire, as the statistics are valuable:

THE FUTURE OF VERMONT IN AGRICULTURE.

Mr. Chairman, Ladies and Gentlemen:

In presenting a paper on this subject, it is not my intention to speak of the place which the "Green Mountain state" shall occupy among her sister states in the coming future as regards her importance in a statistical point of view. That were impossible. We know that in point of wealth and population she is indeed small, and as the great states of the west, some of them almost nations in size, increase in population and riches, she will grow comparatively smaller. But never, if the resources within our hands be properly developed, will she become less in influence and importance. But while we may not know what is to be our relative position in size or wealth, we may consider what we shall do, as agriculturists, in the immediate future. What is to be in the distant future we cannot even prophecy—there are so many new inventions changing the relative positions

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of all trades and occupations—so much is depending on the development of our manufacturing facilities, that no one can tell exactly what is coming. Nevertheless, it is not only proper, but necessary, for us to consider our future, if we do not wish to be left far in the rear.

First—as to whether Vermont offers any inducements to the cultivator of the soil. Shall we cultivate our farms, and try to induce our sons who would follow farming (and by farming I mean cultivating the soil in any capacity, from gardening to stock-raising and dairying,) to stick by and settle among us, or shall we do as many others do—give up farming here, say "It don't pay," sell the old homestead farms our fathers redeemed from the wilderness and loved so well, and "go west," where the soil is better and more easily worked, and the winters less severe? Not every one will become a farmer. It is not to be desired that they should. St. Paul speaks of a "diversity of gifts," and the tastes and talents of different individuals will lead some to choose farming, others the mechanical trades, and still others the literary professions; and this will always be so. While *we* believe thoroughly in agriculture, and that it offers advantages not to be found in any other occupation, it will not be the object of this paper to try to induce others to become farmers. But to show that Vermont—even our own hilly and rocky Vermont—has some advantages not to be found elsewhere throughout this whole great land—to show that opportunities offered here are at least equal to those of any of the far off states whose advantages distance makes seem so great. It is the object of these meetings, as I understand it, to give information, and arouse such a spirit of inquiry as shall make us better farmers and more successful business men. If it can be done, if any word of mine shall make the farmers who listen to me this evening more contented with our beautiful state I love so well, if I can say a word which shall call attention to or arouse thought upon any subject, old or new, that may be made valuable, I shall be well pleased.

There are always two considerations to be taken into account in raising any crop, as a business—the cost of cultivation and the value of the crop. There are many minor points to be considered in each case, but in order to determine the profitableness of the business, all will come under one or the other of those heads. There are so many things to look at, and he who farms it as a *business* of course wishes to do so in that place or that manner which shall give him the greatest returns for the least possible outlay. Thus it becomes a question of great importance to the young man who intends to go

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to farming, where he shall locate. Shall he stay in Vermont or go west?

In order to help us in a measure to determine this, I will make a comparison between Vermont and some other states in some of the leading crops. The ways of cultivation are so different that a comparison between the east and the west is very difficult. But we will take some of our most important crops, one by one, and compare statistics from different states, and see what the results will show.

If one goes west for the purpose of farming, wheat or corn, or wheat *and* corn, are almost sure to be the main crops—this without regard as to whether it is to be sold or fed. Now I propose to show that either wheat or corn, can, on land suitable for the crop, be raised in Vermont to as great a profit as in the middle or western states. In the comparison nothing will be said regarding the other New England states, for it is admitted by all, we believe, that in point of agriculture, Vermont is, at least, equal to any, and it would take too long to bring into comparison all the states from which emigrants go to the west, nor is it necessary.

I will take the corn crop first, and for the purpose of comparison I will take the four states of Vermont, Michigan, Iowa and Kansas. Michigan is a fair representative of the older western states, Kansas of the more recently settled, and Iowa about half way between. For this occasion I have taken my figures from the report of the agricultural department at Washington for the year 1877. The yield per acre, the cost of cultivation, the value per acre and the value of the crop will be given, together with the *average* for each state, and you shall all see how our gallant little state comes out. I doubt not, however, that every farmer before me will see that in any of the states *he* would have been sure of getting a bigger crop. But for the figures—facts are what we are after:

	Av. yield.	Price.	
Vermont,	39.	$ .77	$30 13
Michigan,	31	.39	12 09
Iowa,	32.05	.25	8 01
Kansas,	36.05	.21	7 37
Whole average,	26.06	$35.05	$9 51

The cost of production varies so much in different states that it is hard to make a correct estimation, and each of you can vary the figures I give you to suit your own particular case. In Vermont, I estimate the cost per acre as follows:

Plowing and harrowing,	$ 2 00
Manure,	10 00
Planting,	1 50
Cultivating and hoeing,	5 00

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Cutting and harvesting,	5 00
Husking,	2 25
Interest on land,	3 00
	$28 75
Value of crop corn,	30 13
Value of stalks for fodder,	15 00
	$45 00

Leaving a profit per acre of $16 38.

You may think this estimate of cost is not large enough, but I will try to show, before I am through, that I have under rather than overestimated. I grant that as the work is often done, it costs more, but it need not and should not. In the west, as you will see, the cost of cultivation per acre falls much below these figures. And here let me say to you, that the east can learn much from the west, as well as they something from us, as to means of cultivating crops.

In Kansas the yield per acre, which I have given, 36.05 bushels, is on stubble land, and the cost of cultivation is as follows: Plowing, $1.00; planting, 20 cents; cultivating $1.50; husking, $1.25, interest on land, $1.00; total, $4.95. Deducting this from the value of the crop, $7.37, we have a profit of $2.62. The value of the stalks in Kansas would not more than market the corn, if it did that. In reckoning interest on land, I have called it, all fenced and under cultivation, worth $12.00 an acre, which is a very low estimate. What is true of Kansas is true of Iowa. In Michigan the cost of producing is nearly the same, except that the land is held at a much higher value, and manure is frequently used. I estimate the cost at $9.25, value of crop, $12.09, profit, $2.84. If my estimates are correct, an acre of corn in Vermont will pay 20 per cent profit, in Kansas 15 and in Michigan not quite 3 per cent. The above conclusions may seem strange, but I believe them to be true, and before I leave this part of my subject I will add that in the older of the western states the average yield of corn has decreased 20 per cent in the last fifteen years. How long can this continue and corn be raised at a profit?

In estimating the cost of manure in Vermont, I have given as nearly as possible the amount it would cost to give back to the soil the phosphoric acid, potash and nitrogen taken from it by the grain crop alone, supposing the stalks to be fed or used upon the ground. In estimating, I have called nitrogen 25, phosphoric acid 12, and potash 6 cents per pound. In the west the stalks are not taken from the ground, but are plowed under in the spring, much to the discomfort of the man holding the plow. It has not yet been determined

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how much nitrogen is necessary in a corn fertilizer to produce the best results. From actual experiment I am inclined to think that only a small percentage of the nitrogen found in the crop is absorbed from the soil, and as that is the highest priced ingredient in all commercial manures, it would very much lessen the cost of raising corn, if a considerable part of it could be omitted.

Now we will take the wheat crop and look at the results in the same states, for the same year, 1877:

	Bush.	Price.	Value of acre.
Vermont,	17	at $1.60	$27.40
Michigan,	17.5	at 1.22	21.35
Iowa,	14.5	at .87	11.75
Kansas,	13.5	at .85	11.05

Here again the cash value of an acre of wheat in Vermont is $6.05 more than in Michigan, $15.65 more than in Iowa, and $16.33 more than in Kansas. It is true, however, that this greater value per acre affords no evidence that the real profit is greater. I mean here by profit the returns on the capital invested after all expenses for labor, etc., had been deducted.

I have no data for an exact determination of the cost of cultivation in any of the above places, but we may approximate to the truth; first, as to Vermont and Michigan. In Michigan I know something about it, having spent several weeks, in three different years, in southern Michigan near Kalamazoo, about harvest time. The land here, at two or three miles from the county seat, was valued at $100 an acre—never, I think, at less than $80 for good land. Manure is used on very little of the land as yet. Wheat is followed by clover, and that again by wheat or corn. The cost of raising an acre of wheat in Michigan is about as follows, and I have tried not to overestimate:

Plowing and harrowing,	$2 00
Seed,	2 44
Harvesting,	2 00
Threshing,	1 75
Interest on land,	5 00
	$13 15
Value of crop,	21 35
Profit,	$8 20

This would really be a good profit could it be realized each year, but, as a matter of fact, where no manure is used such a crop of wheat cannot be taken off the land oftener than every other year, and where it is attempted the annual yield falls very low; also the prices quoted are much higher than the different years average, al-

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though that really makes no difference for the sake of comparison, as the same holds true of other states. In Iowa the cost of production I estimate as follows:

Plowing, harrowing, harvesting and threshing,	$5 25
Seed,	1 74
Interest on land,	1 00
	$8 99
Value of crop,	11 75
Profit,	$2 76

Nearly the same would be true of Kansas. In Vermont I estimate the cost of growing and harvesting one acre of wheat at $19.-95; value of crop at average yield, $27.40; giving a profit of $7.45.

In my estimate of the cost in Vermont I have allowed enough to buy artificial manure to keep the fertility of the soil good. I have added nothing for the value of the straw in either case, but it is certainly of much more value here than in the west, where straw is left exposed in the fields to rot and scatter.

It will be easy for any one to draw his own conclusions. It is true that more acres are available for cultivation on the western prairies than here, but, in all my estimates, I have struck a balance between the cost and value of the crop to see which would pay the best profit on the capital invested. Also, I wish to call your attention to the fact that in wheat growing, as in corn raising, the average yield per acre in the west has steadily decreased, until it is 16 per cent less than 15 years ago, while in Vermont there has been practically no decrease. I leave you to judge how long it will be before the yield of wheat in Michigan and Kansas will fall below a point where it can be raised without actual loss. Even to-day, with the prices for wheat what they were one year ago, an investment in real estate in Michigan for the purpose of raising wheat will pay less than 4 per cent. In fact, a shrewd farmer there told me that his beautiful farm, level as a floor, and with the best machinery to work it with, paid less than 2 per cent. It is a fact that will admit of no dispute that, in a few years, all the western states must begin to learn the lesson already partially learned in the east, that an equivalent must, in some shape, be given to mother earth for all the food she yields us. The law, "Give if ye would receive," holds good in this case as in any other.

In the potato crop the figures for 1877 are as follows:

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	Yield per acre.		Price per bush.	Value per acre.
Vermont,	130	at	$ .40	$52.00
Michigan,	83	at	.36	29.88
Iowa,	100	at	.38	38.00
Kansas,	44.4	at	.60	27.29

And, as I suppose the cost of raising does not materially differ in the different states, and $10.00 in artificial manure here in Vermont will supply all that 150 bushels of potatoes takes from the soil, it will easily be seen that potato raising, even with this outlay, is more profitable here than in any of the other states mentioned. I might go on through the whole list of crops raised in all of these states, but I do not think it necessary. I think I have fully shown that average farming in Vermont is or may be as profitable as in any other state. It is true that one man may cultivate more acres on the western prairies than here, but the number of acres cultivated does not determine the profit, and it is also true that only when large acres are cultivated that the cost of production falls to the very low rates I have named, and this requires large capital. With this I leave the first part of my subject and take up the second.

How shall the farming of the future be conducted? First, the farmer must thoroughly learn his business, and then conduct it on business principles. He must study how to produce the greatest amount with the least possible expense. And no farmer will have thoroughly mastered the science of farming until he can do that.

To the young man who would make farming a business I would say; First, determine, if possible, the particular branch or branches of farming you wish to follow, and then select your location accordingly. Certain crops will succeed where others fail; and it will be up-hill work trying to raise crops unsuited to your soil. If you are already on a farm, study hard to find out the nature of your soil and act accordingly, raising always the things it is best fitted for. In the division of labor are the best results secured. This is a principle so fully recognized in the mechanic arts as to need no word of explanation. But I think that what is true in manufacturing is equally true in agriculture, though from the nature of the case the rule cannot be so fully carried out. But it can be done to a great extent; therefore I would have every farmer select some leading crop, and make all his calculations in reference to that. If it be corn, then corn should be grown year after year, whether the price be high or low. If potatoes, if wheat, then the same rule should be followed. Of course other crops should be grown, for the best results are secured by rotation; and besides, it is not safe

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for a man, unless he has a large capital, to have his *all* depending upon a single crop which may fail. But the advantage of having one leading object—as the growing of the corn crop—is, that his closest attention being directed to that, he learns the best and cheapest methods to secure the best results.

Agriculture is a science. In other sciences the specialist is most successful, so why not in this? There is no better place for the study and exercise of the science of agriculture, and no place where it will be better rewarded than in Vermont, where geological formation is indicative of great fertility.

I have said that my estimate of the cost of growing was not high. Here I propose to give you a bit of my own experience in demonstration of this fact. About the middle of last June I planted one-half acre of corn. I planted in drills, the rows 4 feet, 1 1-2 inches apart, putting 4 rows to the rod. It was on sod land. Eight cords to the acre of stable manure was spread on the grass and plowed under. Then some superphosphate was spread on the top and harrowed in, to give the corn a start. I calculated to plant so as to have 20,000 stalks to the acre. After the corn was up I harrowed it once, and during the season cultivated it 4 times. The entire cost of cultivation, from the time of plowing until harvesting, was not over $3 per acre, and there were very few weeds to be seen. The crop eared remarkably well, but owing to the lateness of the time of planting—June 12th, I think—and the early frost which so many of us remember to our sorrow, did not ripen well. A hand hoe was not put into the field. I only give this to show that I believe our crops might be raised at a far less expense than they have usually been. I raised a piece of potatoes—the best 2 acres in 10—at a cost not exceeding $4 per acre for plowing, harrowing, planting and cultivating. A hand hoe was not used, and at the time of digging there were no weeds.

Gentlemen, we can and must grow our crops at a far less expense than we are now doing. I believe that corn can be raised for less than 50 cents a bushel on many a Vermont farm. More wheat should also be grown. If the wheat grower will feed the bran and straw of his wheat crop, and put the manure back on the land, wheat might be grown in the same place year after year without impoverishing the soil.

In the growing of both wheat and corn, clover should be oftener used in the rotation. Nothing is better than a clover crop to improve the farm. He who can get one good crop of clover may, for an indefinite time, raise good crops of anything else.

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The outlook in the future for the farmer in Vermont is to my mind good; but as I said before, he who would be successful must know his business and waste no iota of labor or capital by careless, slip-shod work. To one who is an industrious, careful, searching farmer, Vermont offers in her good soil, her healthful climate, her good schools and her nearness to good markets advantages not often to be found elsewhere.

If time allowed I would like to speak of the chances offered in different places by following out a certain line of operations.

In selecting a suitable farm, not only should the condition of the soil be carefully considered, but its location must be also looked at. For dairying or sheep raising nearness to market is not of so much account; but if vegetables or fruit—especially the small fruits—are to be raised, one acre of land within a mile of your market-place is better worth $100 per acre than $50 per acre 5 miles from market, the quality of the land being the same. The traveling of that 5 miles so often would destroy your profits.

In the coming time all the chances will be, must be, nicely calculated, for close competition will enter into all business transactions, including that relating to farming, and the successful farmer must be as shrewdly studious and painstaking, must combine as many good qualities, as he who follows any other business or profession. Earth, with all her bounteous gifts, must be treated generously and intelligently, or her storehouse will be closed against our ill-directed importunities.

I urge it upon you all, as farmers of Vermont, who love your native state and would see her prosper and rise to occupy the place she should hold among her sister states, to see to it that farm life in Vermont be made attractive to your sons; that the home atmosphere be kept so clear and bright that the malarial of a "western fever" shall have no chance for foothold in their systems. If the sons and daughters of our state can be kept contented and happy, the prosperity of Vermont in the future is assured, for truly contented and happy farmers are always prosperous.

RANDOLPH MEETING.

The union meeting of the state superintendent of agricultural affairs and the agricultural college for Randolph was called by the superintendent of agricultural affairs for Tuesday, the 28th instant, and to be sure to be in good season, we got there Monday night, and

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found we were just in time to attend the regular meeting of the farmers' club, which has had its meetings regularly every Monday evening in winter for more than 12 years.

In this meeting the question of manures was discussed from a practical standpoint—the making, preservation and application. All agreed as to the necessity of making and of housing it, while they were about equally divided as to whether it should be applied green or rotted wholly or partially, and whether plowed under or spread on the surface and worked in for crops.

Mr. G. F. Nutting insisted very strongly that that manure was the best which was applied the soonest after it was dropped, as he had repeatedly proved.

Altogether the meeting was an interesting one, and to these meetings may perhaps be attributed something of that success which has made Randolph so noted as one of the most prosperous farming towns in the state.

TUESDAY.

The meeting was called to order by Superintendent Mead, at 10 o'clock, with an excellent attendance, and N. L. Boyden, Esq., chosen chairman, a committee on programme elected, after which Professor Atwater gave a talk on Fertilizers. After the address there were questions to which he gave replies: Manure will, in its fermentation, lose say 20 per cent of its weight, but has lost little or none of its plant food, but what was left was more valuable for plant food than in its fresh condition. Organic matter escaping from fermenting manure, where it is properly fermented, is not of much value; improperly fermented much does escape, and though some may be absorbed by the growing plant, it is practically lost.

The hour for adjournment having arrived, Chairman Boyden said this meeting had been looked forward to with much interest by the superintendent, and by those inhabitants of the immediate vicinity. He saw here representative farmers from Bethel, Brookfield, Braintree, Chelsea, Stockbridge, Royalton, Pomfret, as well as from remote portions of Randolph. He said the farmers' club had prepared a lunch, of which all were invited to partake, and justice was done to a bountiful and excellent collation furnished by the ladies of Randolph; and after partaking we can say "the multitudes were filled," but we can't say how many baskets of fragments were taken up, but there were several.

In opening of afternoon session Mr. F. D. Douglas of Whiting addressed the audience on Dairying. Mr. Douglas said if he had told them ten years ago that dairying, to be successful, would

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require an amount of thought and study equal to that necessary to acquire a profession, it would have been thought extravagant. Now, perhaps it would be accepted with reservations. We were but upon the threshold of the science. We have made great progress, but investigations had been superficial. The chance for improvement may be seen when the yield of dairies is averaging about 100 pounds per cow, when there are some which produce 300 or 400 pounds per cow, and the price ranges from 8 to 30 cents per pound in open market, while for that sold to consumers direct, an even higher price was received.

He gave some account of the different ways of testing milk, by the microscope and by setting in vessels, and showed an experimental can in which milk is set twelve inches in depth, and in which different samples of milk had given from 6½ to 31½ per cent of cream.

In cheese making it was desirable to have milk with small butter globules, and not in remarkable quantity, while in butter making the large globules and in greater quantity were desirable. In his dairy he had, by adaptation of cows to the butter dairy, secured an increase of 60 pounds per cow, and this when, in the most favorable result, his herd was largely made up of young heifers, as he had but lately begun to keep Jerseys.

There is as great a difference in the quality of the product as in the quantity. He did not now get as many pounds of milk per cow as he did when he made forty pounds less of butter, and it was an interesting fact that as the butter product increased the milk product decreased. He described his method of testing his cows by straining the milk into the cans described and noting the amount and time of rising of the cream, and in this way he can, for all practical purposes, determine the value of the cows for butter making.

He next discussed the philosophy of cream rising, noting the effect of cold and warm setting. Milk kept at the temperature at which it is drawn from the cow will not throw up the cream, but brought down to about 60 degrees will throw up the cream, though slowly; but when reduced to 40 degrees will throw up the cream rapidly, and when a can of milk is set in a freezing temperature it will throw up all its cream before it freezes.

He then considered the best medium for preserving the temperature in cream rising. If you use air as an agent for tempering the milk, it must be exposed to the air, but in water is found the best medium, as it is more easily controlled, and keeps a more uniform temperature. He next explained his method of setting milk in pails, 12 inches deep and 13 inches in diameter at top and 11 inches at

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the bottom, which he sets, when filled with milk, in a tank of water in which he puts ice, which he regards as the best method. He said that large pans were an improvement, but they were a practical and scientific absurdity.

Then he treated of the structure of the butter globule, discarding the theory of the membranous envelope of the globule, and holding that the globule is merely held in suspension, and he therefore condemned what he called the "sledge-hammer churn." He advocated cold setting, but would not use any method of submerging, which he characterized as a humbug, giving his theory for so calling it.

The committee chosen to report on the samples of butter shown reported the exhibit to be excellent, and gave the premiums on the numbers which were on the butter, not knowing the makers.

EVENING SESSION

was opened by a paper by N. L. Boyden, Esq., of Randolph, on laws affecting the rights and liabilities of farmers.

Mr. Douglas was called up for question and explained how he set his milk, which is in pails of size before stated, and are set in vats sufficiently deep to allow of water being admitted to a depth a little more than the depth of milk. In this tank he uses water which he cools with ice, as he has no running water of the proper temperature.

He saves by his method two-thirds of the ice over the Cooley, as it was two years ago when he knew it—he believed they had made some improvement since, which had lessened the amount used. He would prefer a stream of water if it could be had, at about 60 degrees; skims at 36 hours—milk slightly soured; keeps his cream at least 24 hours, especially if intended for butter for long keeping; uses a barrel churn. Cream kept 24 hours will make a little more butter, and better. White specks are chiefly dried cream; washes the butter, putting in the water when the butter is in particles as large as a walnut, and washes in two waters; salts an ounce to the pound; packs directly from the churning in spruce tubs which have been soaked, never less than a week. Would have his cows go dry not less than two months.

Prof. Atwater was next called on, who continued the discussion of fertilizers, giving his attention to commercial fertilizers, showing the results of many experiments made by the farmers the past season in the use of them, and enumerating the various sources of supply of the several different fertilizing ingredients.

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AT WEST RANDOLPH.

The second day of the Randolph meeting was held in DuBois & Gay's fine hall at the West Village, and a full meeting was opened at the morning session.

After the announcing of the programme by the superintendent, and giving some account of the method of the work in these meetings, and the importance of improved methods of farming, and especially in the dairy, which is perhaps the most important in the state, Prof. Atwater gave a talk on feeding stock.

The best rations for feeding was an important thing to find out; and to make good butter it was necessary to know what good butter is made of. He described the composition of different foods for cattle, and their value for the different purposes of making muscle, flesh, fat, milk, butter, etc., which value is chiefly due to albumoids, carbohydrates and fats. He spoke of the very costly experiments made in Germany, which he said cost as much as the seeds which our government bought for congressmen to send out to the people to make them vote for them. (Laughter.)

After a bountiful lunch furnished by the ladies,

THE AFTERNOON SESSION

was called to order at 1:45, and President Buckham addressed the meeting on "The education of farmers." Where he has spoken of the education of farmers, some one jumps to his feet and asks in public, or nudges his neighbor and asks in private, "Are farmers such a stupid class that you need to talk so much of their need of education?" Not so; he believed them to be the most intelligent of those tilling the soil, except, perhaps, the Scotch, who, he thought, more appreciated the value of a higher education than those of New England. The Vermont farmer does not fully believe in the higher education, which statement he made with considerable reluctance, but this statement would not reach those who needed it, for they did not attend such meetings as this; only the more intelligent of farmers. There was one fact he had learned in his connection with the college. More than half of the scholarships were given to those who would say their parents would not help them, though abundantly able to do so, and related instances of this kind from his experience. "What is an educated man?" Much as he had thought of it, it was a question which made it necessary to stop a moment and think before answering it. It was not necessarily a man who had been through college, for one might get through college and

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not be so, but they were trying more and more every year to make it more difficult; and many men who had not been to college were educated men, but they were generally aware of how much harder had been their work in obtaining it than it would have been with better facilities. He believed in an education which would fit the man for the duties of his calling, and more. He did not know as he could find a better definition than that given by Milton, so long ago: "He may be called an educated man who is fitted to perform justly, skillfully, magnanimously, all his duties, public and private, in peace and war," and the farmer was educated who was fitted to fill well all the positions to which he was liable to be called.

The farmer had many places to fill; as a capitalist, as he owned his farm and stock; as a laborer, for he must work his soil, and related an instance where a man started at age with $100, and died with a fine farm of 800 acres, and $40,000 in United States bonds, yet he was not a thoroughly educated man, but he, as a trader, had bought cheap and sold high.

It is certain that as yet science has done very little for agriculture, but agriculture has arrived at the point where the aid of science must be had, and unless we help agricultural chemistry, agricultural chemistry will not help us. The same is true of other branches of science. The farmer must furnish the scientist with facts as starting points. There was a science which bore upon every branch of farming. The farmer applies the principles of a score of sciences. It is a hopeful sign that farmers were inquiring how they can best learn something of chemistry or of insects, and he was receiving letters making such inquiries. He should be sorry to think that any parent would be jealous of his child, fearing he would know more than his father. He hoped the next generation would be wiser and better than this. (Applause.) He spoke of the education, more than half of all, which was necessary to make the man, beside that which fitted him for his calling, as the man is better than his calling can possibly be.

Following President Buckham, Prof. Perkins gave his talk on "Injurious Insects." After Prof. Perkins, J. W. Sanborn, superintendent of the college farm at Hanover, was introduced, who spoke of "How to get out of the ruts, or improved methods." He wanted larger crops on the same area, and larger areas under cultivation. In England 50 per cent of the land was under cultivation, while in our own country not more than 20 per cent. Cultivation is fertilization, and the soil of New England is not cultivated enough, though it was not enough fertilized. He would keep pigs, which he believed

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furnished fertilizers at the cheapest rate, except, perhaps, sheep and poultry.

He next gave the results of feeding pigs, and last year at the price of grain he could raise his pigs at 5 cents per pound and sold them a little more, and this year with corn at $20 per ton, he could raise pork at 4 cents and sell at a little more. To make high feeding profitable, well-bred animals must be kept, and the greatest profit would be found in feeding young stock. In the first 40 days of feeding the young pigs, it required 9 pounds of skim milk to make 1 pound growth, in the second 40 days it took 11 pounds, the third 40 days it took 15 pounds. In feeding for greatest profit the most profitable feed should be used. In feeding middlings about 20 per cent more growth will be made than if fed with corn meal, and a ton of middlings will leave $13 worth of manurial value, while corn will leave but $6 worth.

He next gave account of feeding several lots of steers on straw and shorts and on straw and cotton seed meal, and found they made as good growth as those kept on good English hay, and of 3 lots of steers, 1 lot fed on about 20 pounds of cornstalks, and cotton seed meal, the second on cornstalks and corn meal, and the third on good hay, at a cost varying less than $1 each; and with cornstalks and cotton seed meal he got 155 pounds more growth, and on those fed on cornstalks and corn meal, 100 pounds more growth than on those fed on good English hay at the same cost. And in feeding the cotton seed meal a fertilizer is left worth 6 times as much as that left in feeding corn meal.

Cotton seed meal was more valuable as a fertilizer than the commercial fertilizers in the market, and his neighbors had used bran for a fertilizer and thought it cheaper than the commercial fertilizers. He believed the time had come when the farmers of New Hampshire and Vermont could not afford to be without chemical fertilizers, and he believed it was now a settled question that as good crops could be raised with them as with stable manure, but they must be intelligently purchased, and by that he meant that the chemicals could be bought to better advantage than by buying the formulas or manufactured article. He gave an account of the growth of corn and potatoes with profit from the application of chemical fertilizers. He did not believe that they could be profitably used in Vermont to raise hay, for the margin was too small, but use them for crops which sell at a greater price, as wheat or potatoes, for in the latter about 75 per cent was water, and for $9 worth of these chemical manures he had got 84 bushels addition of potatoes to the crop, which he

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was now selling at 75 cents per bushel. A good crop of clover will leave in the roots left in the ground, enough nitrogen to grow a good crop of wheat, which was secured out of the reach of the roots of the wheat, and made it available for the succeeding crop. A large increase of crops could be secured by a system of rotation of crops, and with a not greater exhaustion of the soil. For potatoes he would buy nitrate of soda and pohsphoric acid, which had proved so successful in his experiments.

EVENING SESSION

was opened by remarks by Mr. Douglas, and followed by a quiz, in which the following was given in reply: He found very little trouble in getting pure water for use with butter, and not much trouble in getting good salt—uses the Ashton factory filled salt. If butter is poor, neither salt nor salt-petre will save it. Cows are adapted to different uses; some for milk, some for cheese, and some for butter, and he detailed his methods of determining the value of his cows for these purposes, as was reported in talk at the Center.

Mr. Nutting described a coloring matter he had prepared from carrots, by expressing the juice, and preserving it with granulated sugar.

Mr. Tinkham spoke briefly of the diseases of dairy cows, which had changed in type from the time when it took two cows to make a shadow in a bright spring day; then they were such as were induced by weakness, now they were those incident to a higher keeping. One of the most common diseases among good cows was that known as milk fever, which he believed might be cured by early and free bleeding. Bleed freely and rapidly to the amount of two-thirds a pailful. Don't allow the blood to run on the ground, but catch it and know how much you have taken. In case of any trouble threatening inflammation bleeding will be found beneficial. Milk fever could generally be prevented by care not to feed too high before dropping of the calf.

Professors Atwater and Sanborn took the platform to answer questions, and mostly on feeding. Mr. Sanborn would not feed bran to milch cows, and could make more and better butter from corn meal than from any other food, peas and oats excepted. Professor Atwater said that he believed that in fifty years the fish pomace of the Menhaden fisheries will be one of the most valued foods for stock.

Mr. O'Connell, member of the farmers' club, read an essay on "How to improve the fertility of our soils," which he answered by

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advocating the saving and housing manure, and generous feeding of the stock and the application of the manures in a green state. The best fertilizers to buy are corn and wheat bran.

The superintendent thanked the ladies who had furnished the lunch for their hearty co-operation, and spoke of the success of the meeting, when the meeting closed, and in point of numbers and interest the most successful one held in the state.

RUTLAND MEETING.

The farmers' meeting for Rutland convened at Village Hall at 2 o'clock P. M., and was called to order by Henry Clark, Esq., who stated the purposes of the meeting and the success of those held in the country.

J. H. Mead, Esq., was chosen chairman, and on taking the chair spoke of the work of the old board of agriculture, of which he was a member, and was glad its mantle had fallen on worthy shoulders. The benefits of these farmers' meetings were plainly seen.

Col. Mead was called by the chairman and made remarks on the necessity of more knowledge in farm matters, of more education, and in the direction of our occupation.

Dr. Cressy was the next speaker, and made some general remarks on the harmony seen in this meeting, where were working harmoniously the superintendent of agricultural affairs, the president and secretary of the dairymen's association, the state agricultural society, the state agricultural college, the Rutland county society, all in unison, and he thought it portended the agricultural millennium. Here we think the doctor got off his nest. He is a professor of veterinary science, but he discussed the methods of increasing the grass crop, of fertilizers, etc., etc., and we believe he would have done himself and the subject more justice if he had confined his remarks to his specialty. After a time he took up breeding, and condemned in-and-in breeding, and breeding for special bumps and cushions of fat on the Short-horns, or for richness of product in the Jersey, but for general health and constitution.

Hon. E. D. Mason, president of the dairymen's association, was the next speaker, and briefly reviewed the work done in agriculture for the last ten years, and he thought the result was cheering. He next spoke of his visit at the international dairy fair in New York, and expressed his belief that if Vermont had made such an exhibit

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as she might have done, she would have taken three-quarters of the prizes offered, including the $250 prize in gold offered by the Higgins' salt company. He spoke of the value of looking up customers for one's products, and the difference in prices realized was sometimes due to the difference in customers more than in goods, and he thought as good butter was sold at 35 or 40 cents as was sold at any price. He replied to questions. Cows were often injured and their product lessened by driving with dogs; care and gentleness will pay; believes it cheaper to make fertilizers than to buy commercial manures, which he believes to be a stimulant for land rather than a food. The fluid portions of manure are worth as much as the solids, and 9-10 of the farmers lose 9-10 of that. Good barns are necessary for good farming, and a good barn has a good cellar. He top dresses his land for grass, harrows in his manure for crops, feeds sweet corn for soiling crop, cuts it and lets it stand 24 hours before feeding. There are many other ways open for profitable farming; in raising poultry, which can be raised pound for pound as cheaply as pork, and sells for twice as much; in raising mutton sheep, and selling the lambs; and many others which must be determined by the location or taste of the raiser.

After Mr. Mason, the meeting adjourned till evening.

The evening session was taken by a talk on farm barns by Mr. Tinkham, on the diseases of cattle by Professor Cressy, and by Col. Mead on improvement of the farm. The meeting was not so well attended as meetings in smaller towns, which may be given as a rule. The smallest meetings of the winter have been at Woodstock, Rutland and St. Johnsbury.

MEETING AT SUTTON.

The state superintendent held a meeting at Sutton on the afternoon and evening of Monday, February 17th, and it was organized by choice of H. A. Blake, president, and John Ordway, secretary, and Nathan Way, C. W. Willey and L. C. Gilman a committee on programme. The first subject discussed was the dairy interest, which was participated in by several gentlemen present, but as we were not present till the close of the meeting cannot report the discussion.

EVENING SESSION.

The meeting was opened by a talk by the superintendent on fertilizers,—what is needed and how to get it. He spoke of the various

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chemical fertilizers, and was not sure that any one was as cheap as they should be, but it was equally true some were much cheaper than others. Farmers often know better than they do, and if they will this year try experiments in fertilization they will secure good results. He spoke of the benefit he had derived from the use of good muck in connection with his stable manure. We must carry on our farms more with a view of permanent profit than for present results.

Mr. Willey inquired how he composted the muck and manure.

Ans.—Draw it out in autumn, and let it lie till April, when it was mixed in May with manure and applied.

Mr. Way said there was plenty of muck in the cedar swamps, and he never knew a load drawn out and treated in any way—warmed up with lime or treated in any other way—that was worth a cent. The muck which was valuable was where hard wood leaves and brush have accumulated and decayed in the course of years.

How to dissolve bones in ashes was discussed, and Mr. Way said lye from wood ashes boiled down, and the bones boiled in it would accomplish that result.

Mr. Tinkham spoke of the experiments tried with fertilizer sent out by the agricultural college, which seemed to indicate that it was chiefly potash and phosphoric acid, and that nitrogen was rarely lacking, following which he spoke of the so often-heard remark, "keep the boys on the farm." Yes, by all means, if he wants to stay. If his bent is decidedly in another direction, don't force him to stay and become a poor farmer, with no heart in his work, instead of a good mechanic or engineer. On the contrary, do not drive them from home by drudgery, by hard work and no pay, by cheerless homes, unlighted by pleasant surroundings, by books, papers, pictures, by flowers and gardens, by pleasant social intercourse, by some little plot of his own to plant, or calf to tend, and then don't sell it and use the money, and tell him that he may have another. Such a course will outrage every sense of justice and right a boy may have, and takes from him all heart for his work. Vermont has no need to be ashamed of her children in other states; their record is an honor to their native home and a benefit to the home of their adoption. Then make home pleasant; educate them to fit them for any station; then let them choose their occupation according to their natural tastes.

A gentleman questioned the superintendent on the cost of the fertilizers used in raising the plants as shown in his charts.

He could not say what it would cost the chemist to produce them

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all. It will be safe to assume that the soil and air and water will contain all the necessary elements for plant growth except potash, nitrogen and phosphoric acid. The cost of these may be ascertained in the markets.

He asked again if it would pay him to buy chemical fertilizers to use on his farm.

Ans.—Can't tell what will pay you—it will pay me.

Q.—At the market price of chemical fertilizers, how much is manure worth per cord?

Ans.—That will depend on the manure. That saved carefully under cover is worth much more than that thrown out under the eaves of the barn and leached by the rains, and the covered manures will be almost as much affected by the feed of the animals making it.

Q.—What commercial fertilizers would you recommend?

Ans.—The kind best fitted to your soil, and which will give you the most profit.

After more discussion on fertilizers, and the relating experiments with the success or failure of the various commercial fertilizers, which seem to be running in sharp rivalry in this vicinity, the meeting adjourned.

LYNDON MEETING.

The farmers' meeting at Lyndon, called to meet the superintendent of agriculture, was called to order in Chase Hall, at 1 o'clock, P. M., on Tuesday, the 18th instant, and was organized by choice of George Ranney, Esq., president, Mr. Pierce, secretary, E. P. Allen and Bradley Ingalls, committee.

The day was stormy, and the attendance was not as large as at many meetings held in the state, but there was a fair number present, and a novelty of the meeting was that of the thirty or forty women present, with bonnets off, and all busy with their knitting as a honey bee on a clover blossom.

The meeting was opened by music from the choir, after which the superintendent made a few introductory remarks, on the needs of agriculture at the present day—the wants of the soil, and improvement in methods.

Mr. E. P. Allen read a paper—"Vermont and her farms."

After some discussion of Mr. Allen's paper, Mr. Kennerson of Peacham spoke of feeding, and against feeding too much concentrated food, and related an instance where a yoke of cattle were so

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highly fed as to injure their growth. He would feed shorts with meal and both with hay. He advocated feeding meal, and raising corn rather than buying it, and thought that it could be raised at less than 50 cents per bushel, and related his experience in raising corn, where he raised 140 bushels of ears of corn on an old, worn out mowing, by the addition of 500 pounds of Bradley's phosphates alone. He planted 3 1-2 feet apart in the rows, and the kernels 6 inches apart. He thinks he gets larger crops so, and that they are more easily cultivated.

Dr. Drew related his experience in feeding straw to his horses and cattle with profit with their grain, and he now bought all the straw he could at $4.50 or $5 per ton, and used all he could raise.

Mr. Brown stated his experience in feeding grain hay; that is, grain cut when just coming into the blow, and he had kept 8 cattle and 2 horses on the fodder grown on 3 1-4 acres, with the straw from 1 acre of wheat, and 3-4 of an acre of corn fodder, and had now a large pile of fodder left, which is cheaper than most are keeping their stock. He had used leached ashes, and to them he had attributed much of his success in his crops, and the effects of their application could be seen 10 years after they were applied.

Mr. Allen supported Mr. Brown's views, while others dissented, though ashes seemed to come out ahead.

EVENING SESSION.

In this session a lively discussion was had, in which part was taken by a large number of those present, on the best methods of applying manures, the profits of commercial manures as compared with stable manures and with each other.

There are more fertilizers of the commercial sort used in this locality than any other we have visited, and the agents of various brands have stirred up quite an interest on the subject, for and against their use, and each others' wares.

In no meeting has there been more interest, or more free and full discussion of the topics presented.

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